

Portraits

of the Network of COSEE Centers



COSEE California developed and disseminates the award winning *Communicating Ocean Sciences* courses; co-leads the *Ocean Literacy* Campaign; and designs tools for Teaching Ocean Sciences in the 21st Century Classroom. The Center launched the MARE Center at Scripps, developed the Marine Sciences Careers website, and helps scientists affect education and outreach.

<http://www.coseeca.net/about/>

Portrait of COSEE California 5

COSEE West partners are a network of oceanographic researchers, K-12 educators, informal education centers and the public. The program is disseminated throughout the greater Los Angeles area, including the Los Angeles Unified School District and other Los Angeles County schools, with exceptional impact on under-achieving and under-represented minorities.

<http://www.usc.edu/org/cosee-west/>

Portrait of COSEE West 8

COSEE Central Gulf of Mexico leverages collaborations through regional partnerships with agencies and organizations with similar missions; enhances exhibits within four informal centers, thereby creating a more ocean literate citizenry along the Gulf of Mexico; and enhances the COSEE CGOM website with resources and programmatic information.

<http://cosee-central-gom.org/about.htm>

Portrait of COSEE Central Gulf of Mexico 13

COSEE Southeast has the mission to spark and nurture collaborations among scientists and educators to advance ocean discovery and make known the vital role of the oceans in our lives. It serves North Carolina, South Carolina, and Georgia. It seeks new pathways with teachers and a growing group of institutional partners of informal learning centers throughout the region.

<http://www.cosee-se.org/about/>

Portrait of COSEE Southeast 17

COSEE New England develops innovative ways to help ocean scientists and informal science and K-12 educators offer high-quality ocean science education throughout New England.

<http://www.cosee-ne.net/>

Portrait of COSEE New England 20

COSEE Ocean Learning Communities is focused on bringing cutting-edge research about the ocean out of the laboratory and into learning communities. These communities can put that knowledge to work so that citizens become better stewards of our marine and aquatic environment.

<http://www.cosee.net/about/aboutcenters/coseeolc/>

Portrait of COSEE Ocean Learning Communities 23

COSEE Great Lakes inspires citizens to become more scientifically literate and environmentally responsible through standards-based science curricula and programs that bridge the ocean and freshwater sciences, and creates dynamic linkages between the education and research community. It adds a critical freshwater component to the National COSEE Network.

<http://www.coseegreatlakes.net/>

Portrait of COSEE Great Lakes 27

COSEE Ocean Systems has the goal of helping the COSEE Network reach rural and inland audiences. The Center creates and evaluates interconnected tools and techniques that enhance Ocean and Climate Literacy by emphasizing the connections between the ocean and the Earth's climate system.
<http://cosee.umaine.edu/>

Portrait of COSEE Ocean Systems 31

COSEE Alaska is one of the newer Centers in the national Network of Centers for Ocean Sciences Education Excellence. It is a regional Center (Alaska) with a theme of People, Oceans, and Climate Change, and is focused on weaving together traditional knowledge and western science to share place-based knowledge of ocean climate change in the north.
<http://www.coseealaska.net/>

Portrait of COSEE Alaska 35

COSEE Pacific Partnerships' primary goal is to integrate marine research and education for audiences that historically have been underserved by the ocean sciences community by developing partnerships based at marine research labs between scientists, community college faculty, and ISEI professionals and volunteers.
<http://www.coseepacificpartnerships.org/about/>

Portrait of COSEE Pacific Partnerships 39

COSEE Coastal Trends has as its mission to increase literacy in ocean science with a focus on understanding how climatic and anthropogenic factors drive dynamic coastal trends through partnerships among scientists, educators, students, and the public. The Center features scientist-educator research programs that culminate in high-quality, media-rich, web-based resources.
<http://www.coseecoastaltrends.net/about/>

Portrait of COSEE Coastal Trends 42

COSEE Networked Ocean World uses transformative ocean research and effective education practices to inspire students and the general public in ocean exploration, discovery, and stewardship. The Center is comprised of several institutional partners who are using real time information from ocean observing systems to enhance public understanding of the ocean.
<http://coseenow.net/>

Portrait of COSEE Networked Ocean World 44

COSEE National Coordinating Office is the hub of the Network, coordinating all COSEE Network activities and providing leadership. The NCO engages in Network-level activities such as the facilitation of broader impact activities, the establishment of partnerships and collaborations, Ocean Literacy initiatives, and the promotion of ocean related careers.
<http://www.cosee.net>

Portrait of the COSEE National Coordinating Office 47

COSEE Ocean Communities in Education and Social Networks, a new COSEE, will engage ocean scientists in education and outreach activities via professional development opportunities. COSEE OCEAN will expand and enhance a two-way exchange of innovation, experience, educational products, professional development models, and best practices.
<http://www.cosee.net/about/aboutcenters/OCEAN/>

Portrait of COSEE OCEAN 50

COSEE Technology and Engineering for Knowledge, a new COSEE, will address the crucial linkages between science, technology, and engineering in the field of oceanography and provide educational resources that highlight the history, breadth, and advancement of oceanographic technologies.
<http://www.cosee.net/about/aboutcenters/COSEETEK/>

Portrait of COSEE TEK 53

COSEE Florida, is a new Center, the goal of which is to engage a spectrum of people and organizations throughout Florida—ocean researchers, educators, and the general public— in a wide range of activities with multiple levels of involvement designed to improve Ocean Literacy both regionally and nationally.
<http://www.coseeflorida.org>

Portrait of COSEE Florida 57



COSEE California was established in 2002 in the first cohort of seven COSEE Centers, and has been continuously fully funded since then. Leveraging the core support from NSF OCE of approximately \$500,000 per year, the COSEE California budget is now over \$2 million per year. The Center has received additional large grants from NSF Informal Science Education, NSF Geosciences Education, NOAA Office of Education, NSF Division of Graduate Education, and the Ocean Observatories Initiative. The Center is based in California, but now has partners in Hawaii and Virginia and funded associate partners in nearly every other COSEE Center. COSEE California relies on this large community of diverse partners to develop programs, strategies, publications, tools and resources that serve and influence a broad audience of scientists and educators nationwide. COSEE California develops products that are in wide use in the field.

In the early years, COSEE California focused equally on the development of its own initiatives and on the building of the National COSEE Network. Within the Center, COSEE California has developed an array of programs that are designed for strategic scale-up, replication, and dissemination. Our goal is to connect ocean scientists and educators in collaborations and partnerships to promote ocean literacy nationwide. COSEE California develops tools, programs, and courses that are in widespread use throughout the National COSEE Network. Beyond the Center, COSEE California invested considerable time, resources, and leadership into the establishment of the National COSEE Council, the COSEE National Advisory Board (later National Advisory Committee), the National COSEE Strategic Business Plan, the National COSEE Blueprint, and several large cross-Center initiatives that established the culture of Network-wide collaboration.

COSEE California began as a partnership between two institutions located in nearly opposite ends of the state: a major science education institution, the Lawrence Hall of Science, University of California, Berkeley, and a major oceanographic research institution, Scripps Institution of Oceanography, University of California, San Diego. In 2007, we added the second largest school district in California and the eighth largest urban school system in the country, San Diego Unified School District, and a well-regarded distance learning organization, the College of Exploration. In 2009, the University of Hawaii, Manoa and University of Hawaii, Maui College joined the Center. With partners spread far apart, each institution within the Center has taken responsibility for leading different initiatives. A Management Team comprised of the Center Director, Center Principle Investigators, the Center Evaluator and the Center Manager governs the Center. The Management Team meets every other week and makes decisions by consensus.

COSEE California has focused equally on infusing more and higher quality ocean sciences into both the K-12 and the informal science education systems. At the K-12 level, COSEE California established a Regional **MARE Dissemination Center at the Birch Aquarium** at Scripps that helps schools in Southern California to implement the MARE curriculum; developed a college course, **Communicating Ocean Sciences to K-12 Audiences** (COS K-12) that introduces undergraduate and graduate science students to K-12 classroom pedagogy and learning theory;

developed a **Marine Careers Web Site** to help high school and college career counselors guide students into ocean-related careers and programs; mounted an international **Ocean Literacy Campaign** to bring more ocean sciences into K-12 science education standards; developed a series of technology-based **Teaching Tools for the 21st Century Classroom**; developed two major commercially available curriculum packages, **The Ocean Sciences Curriculum Sequence for Grades 3-5 and Grades 6-8**, that are designed to be adopted as core science materials by entire school districts or states; and developed a model program (**YO! Youth & the Ocean**) for bombarding a single school with large numbers of underrepresented students with super-enriched ocean sciences learning opportunities. Acknowledging the critical role that out of school learning plays in lives of Americans, COSEE California has also developed a college course, **Communicating Ocean Sciences to Informal Audiences** (COSIA) that introduces undergraduate and graduate science students to informal science education pedagogy and learning theory; developed a professional development program, **Informal Educators Reflecting on Practice**, for use with inservice professional educators in museums and aquariums; extended the **Ocean Literacy Campaign** to influence the development of exhibits and programs in informal science education institutions; developed innovative **Xbox gaming activities** for use in museums and aquariums; and developed a series of out of school opportunities (service learning, research and monitoring, summer school, weekend field trips, residential research camps) focused on the students of a particular school (**YO!**).

In addition to these programs, COSEE California has also established a track record for improving the capacity to ocean scientists to engage in effective, high quality education and outreach efforts. This work has come in three forms: 1) supporting scientists through how-to publications, scientist workshops, and Communicating Ocean Sciences Instructors Workshops in order to learn more about education and how people learn as they improve their own ability to communicate and teach about complex science concepts; 2) developing signature COSEE California programs that showcase highly effective collaborations between scientists and educators; 3) brokering partnerships and collaborations between research scientists and formal and informal education institutions.

Significant Contributions

Engaging Scientists and Educators:

This multi-Center initiative, led by COSEE California, developed, tested, codified, and published effective practices for engaging ocean scientists and science educators in highly effective collaborations and partnerships that increase public awareness and understanding of the ocean. This initiative resulted in the publication:

Education and Public Outreach: A Guide for Scientists

Franks, S., McDonnell, J., Peach, C., Simms, E., & Thorrold, A. (2006). This guide provides basic information for scientists who wish to engage in education and public outreach (EPO) activities. Engaging in EPO can be an excellent way to address funding agencies' requirements that proponents articulate the broader societal value of their research.
http://www.tos.org/epo_guide/

Ocean Literacy Campaign

This Network-wide, international initiative, led by COSEE California, National Marine Educators Association, National Oceanic and Atmospheric Administration, National Geographic Society, and College of Exploration, brought to together hundreds of scientists and educators to define the few essential ideas that every American should understand about the ocean by the end of Grade 12. The goal of the Ocean Literacy Campaign is to ensure that the ocean sciences are represented in our science education systems at the same level of prominence and importance that they are represented in the scientific community. This effort has greatly influenced the development of programs, curriculum, textbooks, exhibits, and state and national science education standards. The initiative resulted in the publications:

Ocean Literacy: The Essential Principles of Ocean Sciences K-12

The Ocean Literacy Scope & Sequence for Grades K-12

NMEA Special Report #3: The Ocean Literacy Campaign featuring the Ocean Literacy Scope and Sequence for Grades K-12

All can be found at www.oceanliteracy.net

Communicating Ocean Sciences

This major initiative, led by COSEE California, involves over 30 universities and dozens of informal science education institutions. Communicating Ocean Sciences seeks to prepare the next generation of ocean scientists to approach education and outreach with the same rigor, quality and enthusiasm with which they approach their research. Communicating Ocean Sciences is comprised of two college courses: one focused on formal science education (COS K-12), and one focused on informal science education (COSIA); a professional development program for informal educators (Informal Educators Reflecting On Practice); and a series of workshops for scientists (COS Scientist Workshops). The initiative has resulted in the publications:

The Communicating Ocean Sciences K-12 Instructors Guide

The COSIA Instructors Guide

The Reflecting On Practice Instructors Guide

All can be found at <http://cos-rop.net>



Los Angeles-based COSEE-West was an unlikely marriage from the start. The project's initial partners, University of Southern California (USC) and University of California, Los Angeles (UCLA), were cross-town rivals whose students and alumni hurled taunts and insults as easily as their football teams traded passes. So when these two warring houses announced their collaboration on an ocean education project called COSEE-West, spectators gleefully placed bets on how long a partnership could last between such storied rivals.

Nine years later, COSEE-West is a force to be reckoned with. Our unrivaled arsenal of innovative approaches brings together faculty from over 12 universities and research institutions, educators from over 8 informal science education centers, and hundreds of teachers from school districts around the world. A partnership with the Los Angeles Unified School District (LAUSD), the second largest school district in the country, enables our scientist collaborators to potentially reach over 2 million under-represented students.

Ocean science education programs existed in Los Angeles prior to COSEE-West's inception, but their reach was often limited. We designed COSEE-West to connect everyone – bringing together scientists, graduate and undergraduate students, educators, and the public.

Our marriage has worked because of the different strengths we bring to the table. Both USC and UCLA are experienced with decades-long outreach and education programs. Before COSEE-West, USC developed informal education partnerships and student engagement programs while UCLA focused on teacher professional development. The College of Exploration (COE) has been a team member and partner since COSEE-West's inception – providing expertise and support on our distance learning projects and evaluation and dissemination of COSEE-West activities.

Over the years, our web has grown to include agencies like NASA's Jet Propulsion Laboratory and South Coast Air Quality Management District (AQMD); corporations such as Southern California Edison and QuikSilver; colleges including several California State Universities; informal partners including Aquarium of the Pacific, Cabrillo Marine Aquarium, Natural History Museum of Los Angeles County, Santa Monica Pier Aquarium, Ocean Institute and Redondo Sea Lab; and formal education institutions such as LAUSD, charter schools, and independent school districts.

Our activities also spawned collaborations within the COSEE Network, including COSEE-CT, COSEE-OS, COSEE-NOW, and COSEE-CA. And we have a more formal partnership with the University of Colorado, Boulder for our COSEE-West Colorado Collaborative – funded in 2008 by NSF to implement a teacher exchange program and promote the involvement of educators in inland areas.

COSEE-West has always emphasized the role of research scientists in education. We've assisted researchers in fulfilling their broader impacts plans by either integrating them into current COSEE-West activities, or by helping them to implement their own ideas – combining their

expertise with the classroom know-how of K-12 teachers and informal science educators to create scientifically current, teachable products that educate a wide-ranging audience. Our activities also extend to connecting scientists and graduate students with each other. We are currently working with COSEE-OS, COSEE-NOW, and COSEE-CA to host a series of collaborative concept mapping workshops for researchers around the country.

The combination of UCLA and USC's leadership in bridging the science and education divide has led to unique partnering opportunities, some of which seek us out. Marina del Rey Middle School approached COSEE-West in 2007 for help in developing their Marine Science Academy, set to open in 2008. So we added a weeklong summer workshop to train academy teachers, of all subjects, in the marine sciences and standards-based activities. Participants included everyone from the principal to physical education teachers and administrative assistants.

We have also developed a weeklong summer workshop focused on Ocean Observing Systems (OOS). Teachers familiarize themselves with ocean observing instruments like buoys, satellites, and remotely operated vehicles – learning to understand and work with the data produced to create OOS-based lesson plans that they can use in their classrooms. Many of the scientist speakers during OOS workshops offered to make themselves available during the school year for further consultations, and opened up their labs to class visits.

Our close partnerships with informal science educators enable us to quickly tailor our programming and resources to better serve their needs as well. Scientists who have participated in our interpretive development workshops get the opportunity to work with educators that see thousands of students and members of the public each year.

In some instances, as with our twice-annual online workshops, the researchers who work with us get a global audience. Educators, administrators, and other researchers from around the world can connect during our online workshops to discuss their ideas and questions with our scientist speakers.

Nor have the general public escaped our attentions. Our role in assisting NASA's Jet Propulsion Laboratory with their Climate Day and the AQMD's Air Quality – Climate Change Conference put researchers directly in touch with not only students, but their families – the mothers and fathers voting on policies and programs that affect ocean sciences today.

An active and involved advisory board assists us in our planning and long-term decision-making. Over the years, we have made enormous strides in gaining both acceptance and active support from a wide range of faculty and senior administrators. Both scientists and educators return time and again to participate in our programs – they have even recruited first-time participants.

During our nine-year tenure, we've been privileged to shepherd an enormous amount of positive change. But new challenges constantly arise. The enduring partnership between two often times bitter rivals has proven even more effective than anything UCLA or USC could have done on their own. The only people who aren't happy with the results are the ones who bet against two warring houses.

Significant Contributions

Ocean Observing System (OOS) Summer Teacher Workshops

These workshops teach OOS content and hands-on activities, enabling educators to integrate OOS content and real-time data into K-12 or informal education settings.

Highlight:

http://www.usc.edu/org/cosee-west/decadalreview/CW_Highlight_OOS_Summer.pdf

Materials and Resources from the 2008 workshop:

<http://www.usc.edu/org/cosee-west/resources.html#Aug08>

Teacher-created lesson plans based on the 2008 workshop content:

<http://www.usc.edu/org/cosee-west/LessonPlans.html#oos2008>

Online Workshops

Nine online workshops feature scientist keynote presentations, chat rooms, and cutting edge scientific research as a way of reaching larger and geographically diverse audiences.

Highlight:

http://www.usc.edu/org/cosee-west/decadalreview/CW_Highlight_Online_Workshops.pdf

College of Exploration hosted virtual campus for COSEE-West:

http://www.coexploration.org/cosee_west/

NARST Conference paper:

<http://www.usc.edu/org/cosee-west/decadalreview/COSEE-West%20Online%20Workshop%20NARST%20Paper%20Final.pdf>

Marina del Rey (MDR) Summer Workshops

These summer workshops enable teachers new to marine research to integrate ocean sciences content into middle school classrooms using a comprehensive, school-wide approach.

Highlight:

http://www.usc.edu/org/cosee-west/decadalreview/CW_Highlight_MDR_Summer.pdf

Materials and resources from the 2008 workshop:

<http://www.usc.edu/org/cosee-west/resources.html#MSWorkshop>

Teacher-created lesson plans based on the 2008 workshop content:

<http://www.usc.edu/org/cosee-west/LessonPlans.html#MDR2008>

Informal Educator Professional Development Series

COSEE-West conducts interpretive development workshops featuring cutting edge scientific research, tailored specifically for a particular informal science center on specific topics of interest.

Highlight:

http://www.usc.edu/org/cosee-west/decadalreview/CW_Highlight_Informal.pdf

Materials, resources, and outcomes from the Climate Change & Whales themed workshop:

<http://www.usc.edu/org/cosee-west/forinformalscienceeducators.html#climatechangeint>

COSEE-West Colorado Collaborative

The COSEE-West Colorado Collaborative, with the University of Colorado, Boulder, conducts educator workshops and a teacher exchange with educators from Boulder and Los Angeles.

Highlight:

http://www.usc.edu/org/cosee-west/decadalreview/CW_Highlight_Colorado_Collaborative.pdf
COSEE-West Colorado Collaborative website:

<http://cires.colorado.edu/education/outreach/cosee/>
2009 Report:

http://www.usc.edu/org/cosee-west/decadalreview/CW_Colorado_Collaborative_Yr1_Report.pdf

2010 Report:

http://www.usc.edu/org/cosee-west/decadalreview/CW_Colorado_Collaborative_Yr2_Report.pdf

Mo'orea Marine Biology Quarter

UCLA's marine biology quarter (MBQ) is a field program designed to give undergraduate students the chance to conduct original field research and gain first-hand knowledge of marine communities.

Highlights:

http://www.usc.edu/org/cosee-west/decadalreview/CW_Highlight_Marine_Biology_Quarter.pdf

Students' blogs written while in the field:

<http://cosee-west.blogspot.com/2010/04/and-theyre-off-to-moorea-that-is.html>

High School Marine Biology Curriculum Developed by HS Teacher

High school biology teacher Mark Friedman developed a marine biology curriculum, in lieu of teaching biology, that meets California science content standards and curriculum requirements for biology.

Highlight:

http://www.usc.edu/org/cosee-west/decadalreview/CW_Highlight_Marine_Bio_Course.pdf

Marine biology course website:

<http://www.usc.edu/org/cosee-west/curricula.html#teachmarinebio>

QuikSCience Challenge and Edison Challenge

The QuikSCience Challenge is an ocean science competition for middle school and high school students. The Edison Challenge is an energy science competition for middle and high school students.

Highlight:

http://www.usc.edu/org/cosee-west/decadalreview/CW_Highlight_QuikScience_and_Edison.pdf

QuikSCience Challenge website:

<http://www.usc.edu/org/cosee-west/quikscience/QuikScienceChallenge.html>

2008-09 Annual Report:

http://www.usc.edu/org/cosee-west/decadalreview/QuikSCience_Challenge_Year6_Annual_Report.pdf

Addendum:

http://www.usc.edu/org/cosee-west/decadalreview/QuikSCience_Challenge_Year6_Annual_Report%202.pdf

Edison Challenge website:

<http://www.usc.edu/org/edisonchallenge/>

2008-09 Annual Report:

http://www.usc.edu/org/cosee-west/decadalreview/Edison_Challenge_Annual_Report_2008-09.pdf

NASA JPL Climate Day

Partnering with agencies such as JPL allows us to reach greater numbers of teachers, educators, students, and the general public on climate change and climate literacy. Over 1,000 students participated each year JPL held a Climate Day.

Highlight:

http://www.usc.edu/org/cosee-west/decadalreview/CW_Highlight_NASA_JPL_Climate_Day.pdf

Climate Day website:

<http://climate.nasa.gov/ClimateDay/>

Demos, activities and resources shared at Climate Day 2010:

<http://www.usc.edu/org/cosee-west/resources.html#climateday>

AQMD Air Quality-Climate Change Conference

Partnering with other agencies allows us to reach greater numbers of teachers, educators, students, and the general public on air quality, climate change, and climate literacy issues. 8,500 high school students participated.

Highlights:

http://www.usc.edu/org/cosee-west/decadalreview/CW_Highlight_AQMD.pdf

Conference website:

<http://www.aqmd.gov/conferences/youth/aworldwecanchange.htm>

Demos, activities and resources shared at the Conference:

<http://www.usc.edu/org/cosee-west/resources.html#AQMDclimateday>



The COSEE CGOM is a unique collaborative, which originated among colleagues and friends within academia and informal centers. This regional effort involves four of the five Gulf of Mexico (GoM) states with the following partners: The University of Southern MS-Gulf Coast Research Laboratory-Marine Education Center, the Institute for Marine Mammal Studies-Center for Marine Education and Research, MS State University and its Center for Education and Training Technology, and the MS-AL Sea Grant Consortium in MS; the University of FL and its Natural Museum of History and the FL Sea Grant College Program in FL; the Dauphin Island Sea Lab and its Estuarium in AL; and the LA Universities Marine Consortium (fall 2002-2007) and currently Loyola University and the Audubon Aquarium of the Americas in LA. During 2002-2006, the University of TX-Marine Science Institute represented TX.

As a region, the GoM is a national treasure and often goes unnoticed for the contributions it provides both within the United States and globally. Compared to other regions, the Gulf Coast region has experienced a significant population increase since 1970, growing by 103%. *Hurricanes Katrina* and *Rita* adversely affected our growing population by displacing thousands of people temporarily and permanently in 2005; however, this region's population is fortunate in rebounding from these events. And, then not quite five years following *Hurricane Katrina* as the worst natural catastrophic event in recorded U.S. history, the citizenry within the GoM were faced with yet another devastating, man-induced coastal hazard, the British Petroleum Deepwater Horizon (DWH) Oil Spill. During the April 20-July 15, 2010 timeframe, over 200 million gallons of oil and more than two million gallons of dispersants were introduced into the GoM, adversely affecting the environment, the economy, and the emotional well-being of hundreds of thousands people in terms of lost jobs and failed businesses and industries, as well as significantly reducing tourism. While data are still being compiled for the negative effects on tourism, commercial and recreational fisheries, to include seafood processors; marine habitats (wetlands, submerged meadows, marshes) and terrestrial habitats (beaches); and stranded (dead or alive) marine mammals, sea turtles, and migratory and shore birds, the indomitable spirit and resiliency of the GoM citizenry remain stronger than ever.

Based on 2008 data, the five U.S. states that border the GoM had a gross domestic product over 2.2 trillion dollars according to the Bureau of Economic Analysis and if a country, the Gulf region would be the seventh largest economy in the world. Four key, economic activities in the Gulf region are: 1) tourism and recreation providing over 620,000 jobs; 2) 27% of the domestic crude oil production is derived from this region; 3) major commercial fishing ports "bring in" over 1.2 million pounds of fresh seafood annually; and 4) six of the top 10 leading shipping ports in the U.S. are located within the GoM.

The GoM is the ninth largest water body in the world and teems with sea life from commercially important seafood to deep water corals. This coastal region contains half the wetlands within the U.S. and serves as a home to sea turtles, marine mammals, nesting waterfowl colonial water bird rookeries, and an incredible diversity of fishes.

The GoM has a watershed of 31 U.S. states and two Canadian Provinces, therefore, it is critical for people within this watershed to be aware and understand the importance of water quality and nutrient reduction, particularly with regard to agricultural and industrial management practices. It is also important that our residents and visiting citizenry, are knowledgeable concerning coastal and watershed habitats; being prepared



for coastal hazards; and the manner in which the economy, the environment, and the GOM as an ecosystem are interconnected. To this end and since the fall of 2002, the COSEE CGOM has served as a catalytic, exemplary regional example in the following areas: engaging scientists and formal and informal educators; the educator gains increased content knowledge based on the interpretations and relevance of current scientific research and the scientists receive a strengthened understanding of instructional skills, state and national standards, and how

children learn; using COSEE CGOM as a mechanism for achieving scientists' grant needs for broader societal impacts in increasing environmental (ocean and climate) literacy of the annual 600,000 public visiting the four informal centers where the Co-PIs are employed. The Co-PIs also assist scientists in the development or refurbishing of exhibits conveying research results or helping in the development of thematic brochures for the public; developing and/or revising 79 lesson plans by middle school teachers and aligning them with the *Ocean Literacy Principles* and linking them to the *GoM State Standards*; and administering, analyzing, and interpreting short-term and select longitudinal evaluation and assessment data of the two, annual three-week Summer Institutes (face to face for one week and an online, distance-learning component encompassing a two-week timeframe with six scientists serving as keynote presenters), involving 12 pre- and inservice educators and five to seven scientists. Similar data are also collected, analyzed, and interpreted for the two, annual Two-Day Workshops involving two to three scientists and "up to" 40 formal and informal educators per Workshop.

The COSEE CGOM Co-PIs have also been instrumental in providing an opportunity for 14 educators to go to sea aboard one of the U.S. Navy's 329-ft. Oceanographic Survey Ships for seven to 10 days through its Sea Scholars Program. Educators work "side by side" with Navy personnel in serving as active participants in making oceanographic surveys which involve chemical, geological, physical, and biological sampling and advanced technologies through the use of side-scan sonar for bathymetric needs and in mapping the seafloor. Efforts in acoustical, meteorological studies, and Naval applications of the data are also implemented to

help increase ethnicity through recruitment efforts with the GoM State Departments of Education, professional societies, and federal and state agencies with the hopes of our educator and scientist participants being able to influence the career paths of their precollege and/or undergraduate and graduate students within the STEM disciplines, particularly the ocean sciences.

Due to the DWH Oil Spill, NSF Program Managers directed the COSEE CGOM Co-PIs to focus their final year of funding (2011) on oil-related findings by GoM scientists with the goal being to enhance the public's understanding of this catastrophic event. Revised Statements of Work and Budgets were submitted in August 2010 and approved by NSF in January 2011 to implement face to face and video conference Community Forums in three locations within each of the four GoM states for "up to" 150 public per state.

Significant Accomplishments-Referred Journal Articles:

- Kastler, Jessica, 2009. "Recipes for Hypoxia, Playing the Dead Zone Game." *Science Activities Magazine*, Volume 46, No. 2, pp. 36-47.
- Sempier, Tracie. 2008. "Teacher Perceptions of the COSEE: Central Gulf of Mexico Programs." A Ph.D. dissertation from MS State University, Starkville, MS. 366 pages.
- Spector, Barbara, Karen Blyler, & Michael Spranger. 2007. "Ocean Sciences and STEM Education: Rethinking Science Teaching," *Current*, The Journal of Marine Education, Vol. 23, No. 2., p. 18.
- Walker, Sharon H. and Susan Cook. 2007. "Collaborations Between Formal and Informal Education," *Current*, The Journal of Marine Education, Volume 23, Number 2, pp. 4-6.
- Walker, Sharon H. and Paula Keener-Chavis. 2006. "The Path to Ocean Sciences Literacy: Essential Steps Along the Way," *MTS Journal*, Vol. 39, No. 4, pp. 20-32.
- Walker, Sharon H. , Craig Strang, & Susan Cook. 2006. "The COSEE: A National Success Story," *MTS Journal*, Vol. 39, No. 4, pp. 33-40.

Impacts of Scientist and Educator Engagement Through Summer Institutes, Two-Day Workshops, and/or the Sea Scholars Program-Over the last nine years, COSEE CGOM Co-PIs, educators, evaluators, and its Advisory Board involved 1,428 formal and informal educators and 198 different research scientists and/or U.S. Navy surveyors—42 of whom each participated in COSEE CGOM Professional Development Programs two or three times in inquiry-based learning experiences. The 2003-2010 online presentations may be reviewed or downloaded on www.cosee-central-gom.org. The 79 lesson plans may also be found on this website.

Additional COSEE GCGOM Collaborators and Grants:

- In 2002-2005, the Office of Naval Research and the National Oceanographic Partnership Program provided fiscal support to add the states of TX and FL, which enabled this effort to be expanded to all five states. The NOAA-National Sea Grant Program provided fiscal support for select staff salaries in the first COSEE CGOM award.
- The Naval Meteorology and Oceanography Command and the Naval Oceanographic Office provided a survey ship for implementation of the Sea Scholars Voyages from 2002-2011, depending on the national defense needs of this country.



- In 2005 the COSEE PI received funding from the NOAA-Ocean Exploration (OE)/National Marine Sanctuary Foundation for the implementation of four, Deepwater Expedition Teacher Workshops February, May, July, and September 2006.
- Pennsylvania State Univ. requested scientist engagement and professional development for educators in 2009. A FLEXE: GLOBE Workshop, “From Local to Extreme Environments,” was implemented in July 2009—funded by the NSF’s GLOBE Project, the Mineral Management Service, and NOAA.
- In 2009, the NSF approved funding for a COSEE CGOM—American Recovery and Reinvestment Act (ARRA) proposal, “Enhanced Engagement by Scientists for Broader Societal Impacts,” on behalf the National COSEE Network. This successful award, i.e., “case studies,” one from each Center being placed on the Network website as they are produced and approved, describes and documents how exemplary scientists use COSEE to develop model E/O programs for broader societal impacts.
- In 2010 NSF awarded the grant, “Responsive Oil Spill Outreach Based in Science,” to two, Co-PIs which complements the fifth year, revised COSEE CGOM effort focusing on the DWH Oil Spill. This grant includes production of three television broadcasts of roundtable oil-spill discussions among scientists and a moderated website (SpillScience.com) that provides interviews with scientists, questions and answers, blogs, and annotated resources regarding the spill.

Local, Regional, National, and International Presentations—The Co-PIs made 164 presentations from 2003-2010. Of this number 82 presentations were local; 17 presentations were regional; 54 presentations were national; and 11 presentations were international.

Public Positively Impacted by COSEE CGOM Efforts—over the nine-year duration of this effort, 5.4 million guests (600,000 guests/yr. times nine years) visiting the Informal Centers in which the Co-PIs are employed have been/are being influenced by the collaborative efforts of participating scientists and formal and informal educators.

COSEE SouthEast (SE) has been administered since 2002 through the South Carolina Sea Grant Consortium with team specialists in education, outreach, research and marine science, located in Charleston SC, Savannah GA, Raleigh NC and Manteo NC.

The southeastern United States contains a powerful suite of universities, most with coastal marine laboratories, and many state and federal agencies that address local and regional marine issues. Informal science institutions ranging from state aquaria and museums to school district science centers have exhibits and programs in coastal and ocean sciences. The public school systems have diverse student populations with over 30% African American and a growing Latino/a population, about 7%. Many of the school systems in rural or low economic geographical locations struggle to have access to any ocean sciences information or professional development opportunities. In many national evaluations, our region is at or below average in student achievement. COSEE SE emerged as a regional Center into this milieu of high quality intellectual and institutional capacity, but challenging demographics.

COSEE SE began as a product of friendships among colleagues from universities, informal science education centers, and education—many attended the 2000 Biloxi meeting that started COSEE. Key partnerships with three Sea Grant programs initiated strong ties to research in ocean sciences, education, and outreach. From this core, the COSEE SE sphere of influence widened through creditable programs that inspired people to be engaged with the principles of Ocean Literacy, transferring current research and technology, and improving science education.

With the first NSF award, COSEE SE gained an identity by building partnerships and professional development programs designed to reach educators, engage scientists, and extend ocean sciences concepts to informal science centers. In its second award, COSEE SE solidified as a regional “go to” program, based on Advisory Committee contacts, program responsiveness and proactive networking. Surveys established rationales and benchmarks in workforce diversity and scientist outreach. In its third award, COSEE SE is emphasizing strategies that provide scientists with opportunities and skills, including the development of broader impacts plans, use of cyber learning, and communities of practice.

The COSEE SE region, bordered by the South Atlantic Bight, includes almost 10,000 miles of beach, estuarine and tidal shorelines. Its newly explored cold water coral ecosystem sparked outreach programs. From scaled-down ROVs to collaborations with scientists who use submersibles, multi-beam sonar, and probes, STEM ROV projects broadened to Coastal Carolina University for freshman orientation, high school science fair projects, and a national competition: in 2010 First Flight High School, Kill Devil Hills, NC, won the Ranger Competition at MATE, CA designing their own ROV.

Then a partnership with the South East Coastal Ocean Observing Regional Association (SECOORA) opened another opportunity for collaborations among oceanographers, engineers, and educators. The development of the prototype “basic observation buoy” (BOB) as a platform for sensors for continuous monitoring exploded the stereotypical format of one-way workshops. COSEE SE with SECOORA and IOOS gathered participants with interests in BOB from K-20

programs and industry. High school students demonstrated sensor limitations to vendors and displayed water quality data to scientists. Graduate students discussed cell phone communication of sensor data sensors with technicians and physical oceanographers. People talked in groups, shared ideas, and built new designs--a community of practice emerged. BOBs are now part of an undergraduate science research methods course at UNC-W, a research project on rice impoundments by The Citadel, a BOB club in two high schools, and part of the COSEE SE STEM elementary science project. The third BOB workshop will include folks from two of the new COSEE programs.

As a result of our continuing outreach to the research community, there has been a steady growth in young scientists contacting COSEE SE about broader impacts strategies in ocean education and partnerships with COSEE SE for implementation. NSF MARGINS scientists from Skidaway Institute of Oceanography included educators on their research trip to New Zealand and in their labs while the educators developed aligned classroom lessons.

While the region's cities have resources for teachers—SC Aquarium, Georgia Aquarium, and NC Museum of Natural Sciences—the COSEE SE network of informal centers and its Ocean Sciences Education Leadership Institutes have taken advantage of local environmental or science centers with unique assets for teachers. Participant/teachers trained in ocean sciences concepts and equipped with lessons, resources, and connections provided peer-to-peer outreach in local sites to teachers who typically do not or cannot participate and now learn about ocean sciences and join the COSEE SE network. One participant from Charlotte brings students for coastal field experiences since his COSEE SE training three years ago. Local science centers become loci for scientist outreach and for distribution of materials from other federal and state programs.

Promoting inclusivity for educators, scientists and students of color through novel approaches is fundamentally important to COSEE SE. We recruit African American educators, seek ethnic diversity in our scientists, and provide funds for African Americans to present at state and national conferences. We present at the annual SC Alliance for Black Educators. Our NSF Opportunities for Enhancing Diversity in the Geosciences (OEDG) award with SC State University (“Sea Seekers”) made connections among research scientists, faculty at SCSU, and undergraduate science majors who mentored a class of 6th graders. The young students engaged in classroom inquiry about the coast led by their mentors, took a field trip to the marine laboratories at Ft Johnson, Charleston, met scientists, and experienced Charleston Harbor and intertidal oyster reefs—a first for many to even see salt water. Students returned to their classroom to investigate questions about oysters, crabs, snails and even test local waters for E. coli bacteria. In a second field trip, students, with coaching from their mentors, presented their results to the scientists. Now, the students could ‘talk the talk’ and ‘walk the walk’. Students were confident as they responded to scientists’ questions. The bright light of achievement shone. Their teacher, who had not worked in marine concepts, presented at NSTA about her lively students.



Research has shown that maximum benefit of attracting ethnically diverse populations stems from initiating programs at the elementary level where students find their identity and embrace science and math as relevant and interesting. The diversity of the ocean sciences workforce will depend on the removal of barriers to ocean sciences experiences and knowledge and incentives for students to choose ocean sciences as a career. Accordingly, our team of science educators, researchers, and teachers targets elementary schools with experiential, inquiry, and ocean themed curricula. A pilot program in Charleston County is poised to expand to GA and NC.

Significant Contributions

COSEE SE has made Significant Contributions within the southeast region and provided models used nationally. We selected eight examples that are found in the Highlights documents of the NSF Decadal Review Documents and the Decadal Review Website.

Ocean Sciences Leadership Institutes were conducted from 2003 through 2010.

These summer PD for educators based on ocean themes, such as undersea research, climate change, estuarine and shoreline impacts and dynamics, integrate educators and scientists, umbrella resources and extend the efforts through one-day ocean awareness days regional.

BOB- -Ocean Observation Technology and STEM emerged from an exciting collaboration among oceanographers, IOOS, SECOORA and educators to bring ocean observing information and technology to K-20 institutions and informal centers.

SEPORT: South East Portals for Ocean Research for Teachers are outreach programs from the Institutes that have introduced new resources and scientists to regional informal science centers.

Ocean Observation learning resources are a collaborative from educators and scientists in the South East Coastal Ocean Observing Regional Associations that resulted in posters, lessons and other resources on waves, currents and circulation.

Diversity Benchmarking was important for COSEE SE in order to mark progress, workforce diversity and identify current initiatives. A regional survey to universities, state and federal agencies reported diversity of their current workforce and thus created benchmarks.

Diversity Initiatives from COSEE SE has initiated novel projects to broaden participation in ocean sciences and gain regional input. These include the Savannah State University and UGA/ Sapelo Island Laboratory interpretative course and summer camp, diversity task force and charrette and projects from NSF OEDG awards.

Scientist Benchmarking was important so COSEE SE could identify regional scientists as well as their outreach projects, challenges and rewards to broader impacts and contact with COSEE SE. This was accomplished through a regional survey.

Remotely Operated Vehicles are used to determine the resources on the continental shelf and beyond by several regional universities and state/federal agencies. COSEE SE partnered with state and national programs to provide new information and technology for the classroom.



New England is a region rich in resources for ocean sciences as well as formal and informal education. It is home to major oceanographic research institutions, numerous private and public universities and colleges, several large public school systems, and many informal science education institutions. COSEE-New England (COSEE-NE) was developed to take advantage of this concentration of resources to *promote and deepen understanding and appreciation of the ocean and its importance throughout New England*.

During 2002-2007, COSEE-NE developed a strong partnership among three major New England institutions—New England Aquarium (NEAq), Woods Hole Oceanographic Institution (WHOI), and the University of Massachusetts (UMass)—and built on this partnership by:

- Using needs assessments and evaluation to build the knowledge base about needs and capabilities of scientists, formal and informal educators regarding their involvement in ocean sciences education
- Creating robust, tested, and adaptable models for scientist/educator interaction and collaboration, and export successful models within the region (and beyond via the National COSEE Network).
- Developing new scientist/educator partnerships to increase the participation of scientists, K-12 educators, and informal educators in ocean sciences education.

As one of the “pioneer” Centers in the COSEE Network, COSEE-NE staff were part of the initial group that established the structures and operations of the Network. Several COSEE-NE members served in leadership roles – as chair of the COSEE Council, leaders of several cross-Center working groups, and participants in cross-Center collaborations.

Over the course of the Center’s work, several factors emerged as central to advancing Ocean Literacy in New England:

1. **A strong regional network.** New England is fortunate to have a dense concentration of science and education resources. There are many existing networks relevant to ocean sciences such as NMEA chapters, active Sea Grant offices, National Estuarine Research Reserves, the New England Science Center Collaborative, etc. However, many of these organizations are isolated from one another and/or struggling for resources. There is a need and opportunity to create neutral territory for collaboration, reduce competition, and focus on common goals.

The Center laid the groundwork for addressing this need by forming the New England Ocean Science Education Collaborative (NEOSEC). NEOSEC is collaborative of 43 institutions from across the region, including aquariums, museums, universities, and science and research centers. It is a strong example of a catalytic collaboration of regional organizations with a common mission. Its focus is on joint programs that build capacity of informal and formal education staff, and engage scientists in education and outreach. Its shared, collaborative governance creates opportunities for many of its members to take on leadership roles.

2. **Focal points for collaboration.** In order for scientists and educators to work together effectively, they need to frame their collaboration around specific themes and content areas.

COSEE-NE helped to develop the foundation for the *Ocean Literacy Essential Principles and Fundamental Concepts*, which evolved in collaboration with the COSEE Network, NOAA, the National Geographic Society, and others. The Center recognized early on that an Ocean Literacy framework is critical for helping scientists to see where their own specialized area of research fits into the big picture, for K-12 educators to make links with curricula, and for informal educators to make their focus areas relevant to their audiences.

COSEE-NE created programs and workshops that used the Ocean Literacy principles as the framework to bring scientists and educators together for joint development of educational programs and products. For example, the *Sharing the Challenge* workshop brought scientists together with informal educators to develop new exhibits in museums in the region on topics such as ocean observing systems and data. In addition, each biannual Ocean Literacy Summit (organized by NEOSEC) focuses on one of the seven Ocean Literacy principles as an organizing theme for the meeting program.

3. **Leverage points to maximize impact.** Given limited resources, it is important to find the most effective leverage points to enhance ocean sciences education in K-12 and informal settings. This includes engaging at the school district level to impact instructional practice, at the institutional level to influence informal education programs and higher education courses, and at the state level to influence standards and assessments.

COSEE-NE's Ocean Science Education Institutes (OSEI) were built around partnerships with school districts, used innovative means and research-based approaches to provide teacher professional development and create educational materials, and provided professional development for K-12 educators. Examples of resources produced for educators can be found at cosee-ne.net/Educators.php.

4. **Efficient mechanisms to engage scientists.** Ocean scientists believe that education and outreach are important, and many want to be involved. However, they are pressed for time and need efficient, proven, and high impact ways to contribute their unique expertise. They require high quality training to prepare for effective engagement with educators, facilitators to help them make connections with educators, structured opportunities for collaboration, and feedback and evaluation to assess their impact.

The *Telling Your Story* (TYS) workshops were developed by COSEE-NE as an innovative approach to improve scientists' ability to be effective in a classroom setting. The workshops engaged almost 90 scientists as well as formal and informal educators, and have been documented and disseminated for use by other institutions. COSEE-NE also participated in the development of a COSEE Education and Public Outreach Guide

for Scientists (see www.tos.org/epo_guide/epo_guide.pdf), as well as many other resources for ocean scientists (see cosee-ne.net/Scientist.php).

Examples of Significant Contributions

New England Ocean Science Education Collaborative (NEOSEC)
www.neosec.org

Ocean Science Education Institutes (OSEI)
www.cosee-ne.net/edu_project_1/index.php

Telling Your Story Workshops (TYS)
www.cosee-ne.net/TellingYourStory.php

COSEE New England Final Evaluation and Impact Report
This evaluation report documents COSEE-New England's impact on research scientists, formal and informal educators, across all of COSEE-NE's programs.



COSEE-Ocean Learning Communities (COSEE-OLC) is located on a piece of water where the Pacific Ocean tides rush twice daily into 80 miles of estuarine fjord nestled between the Olympic Mountains and the Cascade Range in Western Washington. This 13,000 year-old fjord called Puget Sound has 2,300 miles of shoreline and hosts a population of over three and half million citizens who live, work, and play on and around it. In many ways, Puget Sound defines the quality of life for these citizens and many of them donate significant time to protecting, preserving and restoring its waters.

Initially funded in 2005, COSEE-OLC was an unlikely collaboration of ocean scientists, learning scientists and informal science institutions wanting to create and study communities focused on the ocean, especially ones where learning is central. The original collaborators, University of Washington (UW) School of Oceanography, UW College of Education, Seattle Aquarium, and Odyssey Maritime Center (who left after one year) held a vision of reaching some of their own communities with the research and stories of science that can educate, inform and inspire citizens to understand and care about the ocean. COSEE-OLC held this vision while the new collaborators worked to understand one another's culture, priorities and interdisciplinary languages. Through that process, COSEE-OLC became its own first learning community, and thus better understood the challenges of forming and expanding other such communities.

Although COSEE-OLC originally proposed to create one community per annum, this proved overly optimistic as we learned that it takes more than a year to spin up a community. To date, COSEE-OLC has fostered the growth of five overlapping communities (our own, a marine volunteer community, educators, citizen scientists, and ocean researchers). We initially focused on the development of just two – the internal COSEE-OLC community, and what we call the Marine Volunteer Community (MVC) which encompasses thousands of volunteers all over the Puget Sound region who put in time to help protect, preserve and restore it. Only after establishment of these were we able to bring in communities of researchers, educators, and students. We found that structuring our work along three lines (MVC; Science of Learning Research; and Education, Outreach and In-reach) helped bring clarity to our mission and achieve our goals. In 2008, we began to partner with *Ocean Inquiry Project* (OIP), a non-profit whose mission is to educate students, teachers and community members through scientific inquiry using first-hand, on-the-water experience in Puget Sound. OIP received a grant from NSF to collaborate with COSEE-OLC and became our fourth line of work; Boat-based Education and Research.



There are over a hundred marine-focused organizations and institutions in the Puget Sound area that rely on volunteers to provide programming and services for schools and the general public.

These organizations typically operated separately and without sharing much information or resources. COSEE-OLC initially worked with the leaders of a few of these organizations to cultivate a collaborative learning community, what is now the Marine Volunteer Community. Through our workshops, programs, and a partnership with Washington Sea Grant, COSEE-OLC helped expand and nourish this community of actively engaged volunteers to come together to share ideas and resources, network and interact, and learn about current ocean sciences research. The MVC has clearly shown that they are interested in actively learning about and participating in science and research. We developed with them a sense of shared vision and created a nascent learning community of nearly 700 citizens poised to take what they have gained from ocean scientists, learning researchers, and other informal educators to the thousands of people they interact with each year. This is a ripple effect we will continue to support and catalyze further.

The COSEE-OLC team deeply leverages the contemporary view of science learning. In contrast to pursuing separate science “content” and “process” goals, as is typical in science standards and curriculum, the current perspective in research on science learning is that educational environments should integrate dimensions of science proficiency and recognize that individuals learn science best by engaging in the practices of science. Because the COSEE-OLC team consists of learning scientists, ocean scientists, and informal educators, we are uniquely positioned to work with learners in formal and informal learning environments; to build clear, personally relevant cases for the scientific activity they engage in or learn about. COSEE-OLC supports them in exploring scientifically rigorous questions through social and cognitive scaffolds, guidance for participation and place-based inquiry.

The lessons learned in growing the MVC, and learning science research, enabled COSEE-OLC to forge new connections and help launch a group called *Sound Citizen* (SC). The aim of SC is to study the relationship between human activity and impacts on the ocean using chemical signals and cues. SC sends water-sampling kits to volunteers of all ages and analyzes those samples in a UW Oceanography lab staffed mostly by undergraduate students. Additionally, COSEE-OLC expanded this to include underrepresented high school students in SC internship programs with the assistance of the UW Institute of Science and Mathematics Education. SC has become COSEE-OLC’s most successful program for broadening participation of underrepresented populations in the dialog between scientists and citizens. As SC continues to evolve, we foresee it emerging as a significant model for ocean scientists seeking to improve Broader Impacts in NSF-funded grants.

Toward further improvement of Broader Impacts approaches, COSEE-OLC and Washington Sea



Grant hosted a day and a half workshop in early 2010 that targeted practicing ocean researchers with sessions focused on various types of outreach and education. The workshop attracted over 150 participants including researchers, teaching faculty, educators, graduate students, and marine volunteers. Many of those in UW’s School of Oceanography that couldn’t attend due to scheduling conflicts have requested a repeat of this workshop, which we hope to produce later this year.

COSEE-OLC has fostered a close relationship with the *Ocean and Coastal Interdisciplinary Sciences* (OACIS GK-12) program and local area high schools. To broaden this collaboration, SC and the University of Washington Institute of Science and Mathematics Education worked with OACIS GK-12 to develop high school curricular materials called *My Place in Puget Sound*. It is a place-based inquiry science unit that addresses environmental issues with real and current data, is community relevant, and empowers students to act around environmental issues. The culminating event is a public poster session held in the winter quarter at the UW campus. In 2011 over 160 high school students shared their projects with fellow students, scientists, graduate students, citizens and the university community.

A thriving community values and nurtures its next generation members. COSEE-OLC organized poster sessions at some of its events for ocean sciences graduate students to present their research to marine volunteers. When the MVC seized on the opportunities to talk with and learn from the graduate students, we expanded the activity to include graduate students in learning sciences. The poster session is now a central feature of COSEE-OLC activities, and is a noteworthy approach for increasing E&O activities for scientists. Additionally, COSEE-OLC offers the UW courses *Communicating Ocean Science* and *Communicating Ocean Science with Informal Audiences* which is now taught in partnership with Washington Sea Grant. And finally, *Ocean Inquiry Project* (OIP) creates opportunities for ocean sciences graduate students, who act as OIP's primary instructors, to interact in a dialog of sharing and learning while experiencing research first-hand.

We look forward to increasing the size and diversity of the ocean learning communities created thus far and to help them move forward with their own catalytic activities; to help bring the latest ocean sciences information to the public; to study the act of learning in formal and informal situations so as to bring a learning-science lens to all COSEE efforts; to develop tools to help scientists engage with the public in informal venues; and to continue to fostering *Citizen Science* efforts that combine the interests of scientists and students along with the power of a large marine volunteer community to help collect samples and data.

Significant Contributions – For documents, websites and further evidence of COSEE-OLC impact

Nurturing Ocean Sciences and Learning Sciences Graduate Students through capacity building for Education and Outreach. COSEE-OLC serves as an organizing and capacity building mechanism for graduate student programs, to build synergy, leverage funding, and support poster and panel presentations to Marine Volunteers

Link: <https://public.me.com/ava825>

Ocean Inquiry Project is a COSEE-OLC partner which takes non-traditional ocean learning community members on day-long research cruises, to do data collection. Ocean sciences graduate students use cruises a way to learn and use informal teaching strategies.

Link: <https://public.me.com/ava825>

SoundCitizen: a marine-focused, community-based water sampling network, serves as an exemplar to scientists and citizens for how ongoing ocean research can engage citizens and be

educationally and scientifically rigorous.

Link: <https://public.me.com/ava825> See also <https://depts.washington.edu/soundcit/>

Marine Volunteer Community (MVC) events, which connect more than 700 marine volunteers with ocean and learning scientists.

Link: <https://public.me.com/ava825> See also <http://www.coseeolc.net/events-past.cfm>

Sound Conversations is an interactive lecture series, which is designed to engage and inform a general public audience about current ocean sciences. In 2010 COSEE PI, Dr. Rick Keil was featured.

Link: <https://public.me.com/ava825>

Sound Citizen Science Apprenticeship Program For Minority Youth is a leveraged activity linking minority and underserved youth with UW mentors to engage in studies of water quality and to design applied projects in their home communities.

Link: <https://public.me.com/ava825> See also <https://depts.washington.edu/soundcit/archives/68> and <https://depts.washington.edu/soundcit/archives/58>

Culturally responsive, place-based environmental curricula for high school students, typically underrepresented in the sciences. Listed here are research citations and presentations from learning scientists.

Link: <http://public.me.com/ava825>

Educational research on place-based environmental learning pathways of underserved populations. The learning experiences at Riverside Community Center were designed for youth from underserved populations to better understand ocean sciences and gain greater awareness of Puget Sound.

Link: <http://public.me.com/ava825> See also

<http://www.informaworld.com/smpp/content~db=all~content=a919105606>



In the world of ocean sciences education, COSEE Great Lakes (GL) is something of a Cinderella story. For so many years the beauty of the Great Lakes and their contributions to the welfare of the nation were



understated and unsung. Like Cinderella, the Lakes and their educators worked hard and served well, expecting little, their story yet to be told. The Great Lakes of North America span 7°30' of latitude and 16° of longitude, reaching more than 1200 km from east to west and some 724 km north to south. These vast freshwater seas form the north coast of the United States, with more than 16,000 km of shoreline, roughly the same as the Atlantic coast. The Lakes drain over 247,000 square km of watershed and hold 20% of the world's supply of fresh surface water. The eight Great Lakes states are home to 82 million U.S. citizens, more than one-quarter of the nation's population, of which more than 13 million are K-12 students.

With the inclusion of a Great Lakes program among the Centers for Ocean Sciences Education Excellence, and concurrent federal recognition of the Lakes as a key component of ocean policy, the values and wonders of the region and the contributions of its dynamic scientists and educators have been recognized. Educators in the seven Sea Grant programs of the Great Lakes – MN, WI, IL-IN, MI, OH, PA and NY – were regulars at ocean education's royal ball, having hosted the National Marine Educators Association's (NMEA) annual conference three times, providing a President for that organization, leading the Sea Grant Educators Network and a regional chapter of NMEA, and offering the greatest number of published works in marine and aquatic education through the 20th Century (Fortner, 2010). Yet for these Sea Grant educators, activity was primarily confined to their respective states; opportunities for multi-state efforts in marine and aquatic education were rare, and working as a region was mostly done ad hoc, unfunded.

When the COSEE request for proposals came out in 2005, the slipper fit. A COSEE for the Great Lakes was seen as the next step toward recognition of that hidden beauty and potential for ocean sciences education contributions. The seven Great Lakes Sea Grant programs crafted a proposal to do regionally what they had previously done only in states, to build together a program based on educational research, science excellence and outreach expertise. Our goal was to share the science of the sea using lake examples with regional educators, and Great Lakes science with ocean educators. It is all the same science. COSEE support gave our network of existing collaborators in schools (including five of the 100 largest school districts in the U.S.), informal institutions in each state, and science laboratories and research consortia the chance to expand the quantity and quality of education efforts, develop innovations in outreach to scientists, and reach greater numbers of underserved groups in the region.

The "Fairy Godmother" of our story is NOAA's Office of Sea Grant. Noting that the COSEE Great Lakes proposal originated in the work of Sea Grant Education, with NOAA personnel in leadership roles, the agency stepped forward to provide half the funding for the 2006-2010 COSEE program. This partnership assured support of the state Sea Grant offices with their

considerable connection to aquatic sciences, resources for communication and contact networks, and the cross-agency collaboration essentially provided twice the program visibility. Another critical contributor to regional efforts was the U.S. Environmental Protection Agency (EPA) through its Great Lakes National Program Office (GLNPO). This agency offered COSEE GL the use of its primary research vessel, the 180-foot *R/V Lake Guardian*, for one week each summer to host a “Shipboard and Shoreline Science” workshop for educators. The experience of 15 educators living aboard ship with scientists and learning about complex lake systems through authentic science data collection protocols emerged as the most valuable of our annual events in terms of impact on conceptual change among educators and attitudinal change among scientists (Walters & Fortner, in preparation).

Along the way to our Great Lakes goals, this COSEE contributed to the upkeep of the COSEE “household.” Unlike Cinderella, however, our contributions were not menial ones. COSEE GL contributed to common outreach efforts such as the *Current* special issue, the development of marketing and visibility plans and materials, presence at national conferences, leadership and participation in Working Groups, and teaching the *Communicating Ocean Sciences* course at the University of Michigan. Always happy in our work, we reviewed songs for Ocean Literacy (OL) and assembled our own musical *Tribute to the Great Lakes*, free to educators. The Ocean Literacy we taught in our workshops was enhanced by editing a special edition of *Science Activities* magazine (2009) and development of the *Great Lakes Literacy Principles* (GLLP, 2010) through a collaborative grant from COSEE CA. The GLLP mirror OL principles and make it easier for our regional audience to make ocean connections. At the same time, COSEE GL educators and scientists feel pride of ownership with GLLP and plan greater uses of them in outreach.



Teachers aboard EPA's Lake Guardian learn to extract water samples.



Hannahville (MI) Indian School students learned lake science firsthand with partner Inland Seas Education Association.

The main tasks we built for ourselves in our COSEE region were focused on professional development (PD) for educators and scientists. We did our homework, basing efforts on baseline studies of scientist and educator collaboration, teacher priorities for Great Lakes education, student knowledge of the Great Lakes, and evaluations of existing workshop models, both for face-to-face and online professional development. The research base provided background information to establish content that was likely to be used, and methods that were proven effective in the literature. To fulfill our responsibility to the professions of science education and ocean sciences, our program practices and evaluation results are being prepared as contributions to journals.

Informal and classroom educators were served through land-based and shipboard venues, long workshops and shorter Teachable Moments, curriculum collections to take the learning home, Marine Immersion scholarships to enable participation in partner programs, and online programming to bring scientists together on a key topic and make their presentations accessible. PD for scientists, called Limno-Links for Lake Science connected to learning, took the form of a biennial School for Scientists at the annual conference for the International Association for Great Lakes Research (IAGLR), and Educator House-Calls, in which educators visited science facilities to discuss their needs and how the scientists could connect with education audiences. Scientists also reported that their experiences with educators in the workshops and as conference co-presenters were a great form of professional development.

Other tasks related to new audiences for Great Lakes education. We intentionally targeted underserved groups of educators and scientists through connections with large urban school districts, tribal schools and IAGLR/Sea Grant scientist networks. We had much success in reaching underserved groups among younger audiences, as we facilitated student experiences with Great Lakes science through partner programs. O'LAKERS (Ocean/Lake Aware Kids Engaged in Relevant Science) support filled "the \$400 gap," the cost of bus rental, which prevents many classrooms from ever seeing the Lakes as their teachers have seen them. Through O'LAKERS we targeted urban and tribal groups, serving over 2900 students of which at least 78% were from majority underserved groups (schools in Chicago, Detroit, Milwaukee and Cleveland have < 20% Caucasian students).

While Cinderella had only her fairy godmother to help her find the magic that would show the world her worth, COSEE GL assembled a confederation of all the Great Lakes Sea Grant Educators, working with their science partners in IAGLR, Sea Grant researchers, NOAA's Great Lakes Environmental Research Laboratory, and the Cooperative Institute for Limnology and Ecosystems Research, plus key informal science education institutions in each state. Together they fulfilled the dream of effective ocean sciences education for the Great Lakes, and formed lasting alliances built on contributing together to the future health of the Great Lakes and oceans through an informed citizenry. Their story is being told in a series of white papers for current review and eventual publication (*Summit*, 2011). Midnight came and went with no additional funding, but the magic COSEE GL coach continues to roll as leaders are collaborating on several multi-state grants from NSF and EPA that began with COSEE ideas and connections. This is one coach that won't turn into a pumpkin.

Resources in support of the COSEE GL story (citations above and contributions not included in Highlights)

COSEE GL, 2010. *Great Lakes Literacy Principles*. Online at www.greatlakesliteracy.net and described in Fortner, R.W. and L. Manzo, 2011. Great Lakes Literacy Principles. Eos Trans AGU, March 28.

Fortner, R.W. (Ed), 2009. *Ocean Literacy*, Special Issue, *Science Activities* 46(3). <http://coseegreatlakes.net/news/20090819>

Fortner, R.W. (Ed), 2010. Abstracts of research in marine and aquatic education, 1975-2010. http://beta.w1.oesd.noaa.gov/pubs_reports/2010_Fortner_MarineEducationResearch.htm

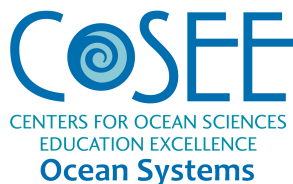
Great Lakes Education Summit, 2011. *Sweetwater Seascape* 4(1). Online at <http://coseegreatlakes.net/newsletter/nl16.html#article3>

Walters, H. and R.W. Fortner (in preparation). Comparative impact of shipboard and land-based professional development on conceptual change among Great Lakes educators (working title).

Online workshops presented a Great Lakes overview, plus special focus on regional geosciences and ecosystems, and an opportunity for contribution to summary white papers from the Great Lakes Education Summit. Programs reached a total of 1042 educators and scientists over five years. http://coseegreatlakes.net/summit/downloads/GL_CBLIS-CoE.pdf

Scientist Engagement brought excellent researchers into contact with educators for opportunities in workshops, classrooms, co-presentations, and curriculum assistance. One example is Dr. Greg Boyer, the focus of this resource item: <http://coseegreatlakes.net/summit/index#evidence>

Research that informed the structure and content of COSEE GL professional development included baseline research specific to collaboration (<http://coseegreatlakes.net/summit/index#evidence>)



“The primary benefit is to be part of a network of organized education and outreach efforts rather than trying to come up with good education and outreach components on your own,”

Pete Jumars, School of Marine Sciences Director, University of Maine

Like most good stories, the tale of COSEE-Ocean Systems (OS) is about people. The trajectory of COSEE-OS has been influenced by individuals ranging from high school students (Bangor, Gardiner and Waterville, ME) to External Advisory Committee member D. Bob Gowin, concept-mapping pioneer (San Carlos, CA). This is a tale about working with different groups to develop ocean sciences education models while assiduously soliciting and incorporating feedback and remaining flexible and responsive to a variety of different needs.

Since its inception in Fall 2005, COSEE-OS has supported the Network by developing transferrable online tools and processes that effectively bring ocean sciences research and educational resources to broad audiences. This Center has focused on reaching rural and inland audiences while helping scientists better communicate -- and non-scientists clearly see -- connections in the ocean-climate system. Early on, COSEE-OS solicited input from a core group of dedicated educators and researchers who analyzed the *Ocean Literacy Essential Principles* with the goal of identifying a thematic focus for the Center to use in developing resources and tools. The theme they chose was: *“The ocean is a major influence on climate.”* Soon after, COSEE-OS piloted the use of concept mapping – a process in which people use connecting lines and phrases to display the relationships among concepts – to get a dozen research scientists and educators “on the same page.” This technique had already been shown to be a valuable pedagogical tool for assessing students’ understanding (*Novak and Gowin, 1984*). Upon discovering that the vast majority of scientists had never heard of concept mapping, COSEE-OS began using this graphical tool to help them better communicate about their research and articulate their thinking processes. Thus COSEE-OS began its long-term plan to test the efficacy of using concept mapping to help scientists deconstruct complex knowledge into core components for specific audiences (*deCharon, 2009*).

“Don’t worry about the details, just figure out what you want and we’ll come up with a way to make it work” Sean Graham, 2006, COSEE-OS multimedia developer

A major outcome of an early Center meeting was a consensually prioritized list of targeted “ocean-climate” concepts for inclusion in COSEE-OS resources and materials. Working in teams, scientists and educators collaborated on a series of concept maps; these ultimately were used to design the first COSEE-OS interactive online tool, the *Ocean-Climate Interactive*. Users can explore this multimedia interface to learn about ocean and climate topics through its extensive database of scientist-vetted resources, “assets” that include over 2500 images, videos, news items, and teaching resources. A companion online tool called the *Concept Map Builder* was then developed to facilitate the creation of scientist-generated maps hyperlinked to the COSEE-OS asset database. These early collaborations culminated, after years of field-testing and feedback from users, in a suite of resource-rich tools known collectively as the *Concept-Linked Integrated Media Builder*.

“Working together on a concept map was key -- as was having (the scientist’s) map from the day before to springboard from -- it was a true collaboration” Beth Marass, 2007, Sanford High School

The synergy and productivity of those early scientist-educator meetings inspired the development and testing of COSEE-OS collaborative workshop models. Each model has two overarching design principles: 1) to foster mutually beneficial, peer-based interactions between scientists and non-scientists; and 2) be flexible enough to be transferred to other Centers. An innovative matchmaking process centered on literacy principles ensures that scientists address audience-specific content needs at the appropriate level. To build the capacity for other groups to implement the OS model, workshops are fully documented online and include concept maps, presentation videos, and evaluation results. Collection and analysis of evaluation data -- from participants and new COSEE facilitators -- are key to improving the workshop itself and the workshop transfer process.

“I liked learning concept mapping myself but think it would really be beneficial for my graduate students” Peter Girguis, 2008, Associate Professor, Harvard University

The first workshop model, Scientist-Educator Collaborative (SEC), was the result of a rigorous research and development process. Evaluation results from the SEC workshop series indicated that COSEE-OS has increased the capacity of scientists and educators to effectively communicate about complex science: 91% of educators agreed that concept mapping helped them “think through science topics” and 89% agreed that it helped “build a bridge of communication with scientists” (n=53). After several participating scientists commented that they wished their graduate students would learn the technique, the SEC was retooled into a new workshop model, Faculty-Graduate Student Collaborative (FGSC). In FGSC workshops, graduate students receive feedback from a mixed audience on their presentations, sometimes with surprising results: e.g., advice from high school students is very highly valued. SEC and FGSC model workshops are now being implemented by four other Centers (Pacific Partnerships, California, NOW, and West).



One scientist-educator team works on a concept map during SEC workshop at the University of Connecticut (Oct. 2009).

“The next thing you should think about is how to ‘scale up’ your workshops” Fred Shair, 2009, retired Caltech Professor and External Advisory Committee member

Lessons learned from in-person collaborative workshops, coupled with the Center’s goal to reach inland and rural audiences, prompted COSEE-OS to pilot a series of concept map-focused webinars. The first series, *Research-based Online Learning Event (ROLE) Model Webinars*, was designed to maximize scientists’ impact with a relatively small investment of their time. For example, scientists have expanded the scope of an existing concept map to include a current news topic (e.g., oil spill). These webinars allow scientists to extend their reach both geographically and topically, interact with a wider variety of audiences, and build new relationships beyond their academic communities. To further increase their reach beyond the

webinar, COSEE-OS also assists scientists in writing effective blog posts. Archived webinars and blogs allow additional asynchronous access to scientists and their expertise. In 2010, ROLE model webinars reached 193 participants in 27 states and the District of Columbia, 41% of whom were located in rural or inland areas. 92% of those surveyed stated that their comfort level with the scientist's presentation topic had increased, and 91% felt that the webinar was useful to very useful in their own work. In the 2010 Scientist Engagement Survey, of the eight scientists for whom it was applicable, 100% agreed with the statement "Presenting in a COSEE-OS webinar helped me deconstruct my complex science for a non-scientist audience."

"The booklet is by far our most popular download" Ellen Kappel, 2010, "Oceanography" Editor

Another example of how COSEE-OS has focused on reaching rural and inland audiences is the publication *Teaching Physical Concepts in Oceanography* (Karp-Boss et al., 2009). This booklet was incrementally developed through a series of summer workshops and an undergraduate course offered by University of Maine faculty in marine sciences and education. To better reach non-traditional ocean education audiences, focus was placed on physical (i.e., rather than biological) science concepts such as density, waves, pressure, and energy. By design, these "hands-on" activities can be used by educators who teach non-marine-related courses but are interested in infusing ocean sciences into established curricula. The correct implementation of these activities is aided by online videos that describe how the experiments should be set up and executed.

"Ocean sciences education should remove barriers to and support participation in ocean science research endeavors and provide meaningful learning experiences to support the multiple goals of promoting Ocean Literacy for all, college-readiness, and pathways into STEM occupations" 2010, COSEE Community Meeting Report

As new collaborative tools have been developed and online events widely advertised, the Center's reach has broadened. For example, through January 2011 over 1,700 individuals had registered with COSEE-OS to create over 1,800 concept maps. Moving forward, COSEE-OS is expanding its scope by supporting the involvement of individuals traditionally underrepresented in the ocean sciences academic pipeline. The Center's successful renewal in Fall 2010 included the addition of an important new partner, the Institute for Broadening Participation (IBP). IBP was founded to design and implement strategies to increase access to science, technology, education and mathematics (STEM) education and careers for diverse underrepresented groups. IBP has developed a successful model for supporting national networks that increases the number of underrepresented students successfully pursuing STEM careers. An early outcome of this new partnership is a diversity-focused webinar series being developed in collaboration with COSEE-Ocean Learning Communities.

"I'm exposed to new ideas and tools that enable me to broaden the impact of my research. When presenting the results of my work, I now always think of the wider audience... and ways that accommodate for different styles of learning. COSEE-OS pointed me to resources that extend my capability to communicate results of my science with a wider, non-scientific audience" Artur Palacz, 2011, 5th year Ph.D. student, University of Maine

In the future, the Center will steadfastly broaden its portfolio of effective practices that positively impact scientists. In a recent survey, scientists agreed that their teaching (79%) and effectiveness in delivering research presentations to non-scientific audiences (75%) have been improved through involvement with COSEE-OS (n=24). Exciting new partnerships afforded by the Center renewal, such as with the Northeastern Regional Association of Coastal Ocean Observing Systems, will help COSEE-OS test other innovative ways to engage scientists. Moreover, through the development of tools for online collaboration and use of social networks, COSEE-OS will help scientists not only “Think Globally, Act Locally” but “Act Globally,” as well.

Significant Contributions

To learn more about COSEE-OS, please visit

<http://cosee.umaine.edu/about/publications/highlights/>

to access PDFs on these topics:

Interactive Software Developed Through Iterative Feedback Processes

Building Consensus and Understanding Through Collaboration

Scientist Participation in Education Conferences and Venues

Faculty-Graduate Student Collaborative Workshop Model

References

deCharon, A., J. Albright, C. Herren, A. Cline, and J. Repa (2009), *Online Tools Help Get Scientists and Educators on the Same Page*, *Eos, Transactions, American Geophysical Union*, 90(34): 289-290.

Karp-Boss L., E. Boss, H. Weller, J. Loftin, and J. Albright (2009), *Teaching physical concepts in oceanography: an inquiry-based approach*, *Oceanography Suppl.*, 22(3), 1-52.

Novak, J., and D. Gowin (1984), *Learning How to Learn*, 199 pp., Cambridge Univ. Press, New York.



It takes a village.... The time-honored African proverb speaks of the importance of community. Some say it originated from the Nigerian Igbo culture and proverb "Ora na azu nwa," which means "it takes the community/village to raise a child."

Thousands of miles away in America's Arctic state, communities large and small make up the core of COSEE Alaska. The ocean science community, together with educators, Alaska Natives, rural coastal communities and informal educators all work together to raise children steeped in traditional knowledge and western ocean sciences during a time of dynamic climate change.

COSEE Alaska is settled in downtown Anchorage, the state's economic hub and one of Alaska's largest villages, with more than 23,000 Alaska Natives representing nearly a quarter of the statewide Alaska Native population. Satellite offices nestle in Seward and Fairbanks.

Even Alaska itself, more than twice the size of Texas, is in many ways a village of little more than half-a-million people in a state that touches more sea than the rest of the United States combined.



Coastal communities here have existed for eons and harbor deep knowledge of human interactions with arctic environments. Five indigenous groups of Alaska Natives bring collectively thousands of years of place-based knowledge to an understanding of our planet's changes. Western "modern" science however, has only begun in the last 100 years to quantify the interactions of humans and the environment in Alaska.

COSEE Alaska seeks out elders and youth in these communities and rural school districts to bring this vast historical knowledge to the forefront of scientific awareness and to the broader public.

Why create a COSEE in Alaska given its relatively small and remote population of 660,000?

Maps too often depict Alaska in the center of the Gulf of Mexico, far from its wild and remote marine ecosystems rich with undersea communities that are vitally important to this nation. Few outside Alaska know that Bering Sea fisheries provide nearly half of the wild-caught seafood consumed in this country. And these seas are some of the most sensitive ecosystems to a warming climate regime. Indeed, the polar bear – a major predator in Alaska – may soon be listed as an endangered species because of shrinking ice habitat in the Beaufort and Chukchi Seas. New Arctic maritime transportation corridors could become accessible within several decades as seasonal sea ice coverage declines. Alaskan glaciers and ice sheets are melting at an unparalleled rate. Fish populations are shifting their geographic distribution patterns in response to increased ocean temperatures, potentially driving fishing fleets to new and sensitive areas. Alaskan coastal communities are directly experiencing the impact of a warming climate with more intense fall storms, increased coastal erosion, and instability from melting permafrost, all of which are beginning to shift community behavior patterns.

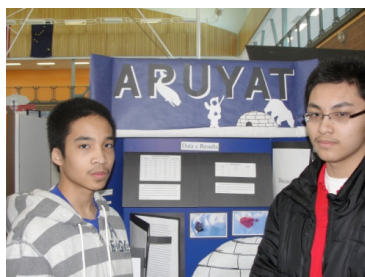
Unique to Alaska is the level of interaction with and dependence upon coastal fish, seabirds, marine mammals, and marine vegetation experienced by residents of coastal and river



communities. Eighty percent of Alaskans live on the coast and in some communities in Western Alaska, more than 600 pounds per person of subsistence-harvested animals and plants are consumed annually. Daily lives of Alaskans are impacted by weather, and as a result, traditional and local knowledge of natural cycles is strong in rural Alaskans.

COSEE Alaska joined the broader national COSEE community in August 2008 as a regional and thematic Center, forging a partnership among the Alaska Ocean Observing System, University of Alaska Fairbanks School of Fisheries and Ocean Sciences, Alaska Sea Grant, Alaska SeaLife Center, the University of Alaska Fairbanks Center for Cross Cultural Studies and the Anchorage School District. Leaders in the business community, government agencies, nonprofits and coastal communities embraced the new COSEE and became a COSEE Alaska Advisory Council to guide and strategize partnerships with other communities. Dr. George Matsumoto of COSEE's National Advisory Council took the fledging Center under his wing, engaging in signature programs and facilitating workshops.

Through coastal ocean science fairs and *Communicating Ocean Science* Workshops at Alaska's major science symposia, COSEE Alaska not only provides to the public the awareness of how climate change is already impacting the U.S. Arctic, but also brings back to coastal communities information on the global attempts to study and mitigate the impacts of change. In villages throughout coastal Alaska, COSEE Alaska brings together elders and scientists, who work side-by-side in mentoring students and judging ocean science fair projects,



weighing both cultural relevance and scientific merit.

A community of teachers who have gone to sea with researchers joined forces with the ocean scientists in a Bering Sea professional development workshop co-hosted by COSEE, the North Pacific Research Board, the EARTH Workshop and the Arctic Research Consortium of Alaska's PolarTREC program. They created a rich and diverse Bering Sea Ecosystem Collection for a national audience that lives online at the website of the ARCUS program at

<http://www.polar-trec.com/collections/bering-sea-ecosystem>.

At the graduate student level, COSEE Alaska piloted the COSIA course developed by COSEE California at the University of Alaska Fairbanks, adding traditional knowledge. As part of the course, instructors shared videos from the *Faces of Climate Change* collection, produced by COSEE Alaska with the Alaska Sea Grant Program, Alaska Ocean Observing System and Alaska Marine Conservation Council. These compelling short videos showcase the dramatic changes in Alaska's marine ecosystems through interviews with scientists and Alaska Natives, and live on the virtual community of the COSEE Alaska website.



A greater community gathering occurs each January at the week-long Alaska Marine Science Symposium, where more than 1,000 scientists share their research in Alaska's seas with educators, community members and media. During the event, COSEE Alaska co-sponsors a

Communicating Ocean Science Workshop, linking ocean scientists with educators and journalists to showcase best practices in outreach and in communicating science with diverse audiences. Growing out of these annual workshops, a virtual community sprang to life, known as SEANET, or Scientists and Educators of Alaska Network, found at <http://oceanseanet.ning.com>.

Significant Contributions – For documents, websites and evidence of COSEE-Alaska's Impact

Alaska Marine Science Symposium—*Communicating Ocean Science* Workshop is a forum at the Alaska Marine Sciences Symposium for ocean scientists, educators, journalists and members of coastal Alaska communities to share education and outreach strategies and practices.

Link: <http://www.coseealaska.net/resources/coseepublications/>

Ocean Science Fairs for Coastal Communities help students focus on integrating traditional ecological knowledge with western ocean sciences understandings with posters that are judged by both ocean scientists and by Alaska Native elders for both scientific rigor and cultural relevance.

Links:

<http://www.ankn.uaf.edu/publications/> (see “Alaska Native Education: Views From Within” and “Sharing Our Pathways: Native Perspectives on Education in Alaska,” both edited by Ray Barnhardt and Angayuqaq Oscar Kawagley)

[http://www.coseealaska.net/files/alaska/COSEE Manual for Ocean Science Fairs, Science Projects, and Camps.pdf](http://www.coseealaska.net/files/alaska/COSEE%20Manual%20for%20Ocean%20Science%20Fairs,%20Science%20Projects,%20and%20Camps.pdf) (Use Firefox or Internet Explorer Browsers)

SEANET, organized by COSEE Alaska, is a self-governed, informal network of scientists, educators and other people involved in communicating about research in Alaska's seas.

Links: <http://www.coseealaska.net/seanet/> and <http://oceanseanet.ning.com>

Faces of Climate Change Videos

COSEE Alaska partnered with Alaska Sea Grant and Alaska Marine Conservation Council to develop a series of videos weaving together interviews with Alaska Natives and western scientists to help educators and the general public better understand climate change and the corresponding impact on the peoples of Alaska. Current titles include: 1) Introduction to Climate Change in Alaska's Seas; 2) Disappearing Sea Ice; and 3) Life on the Ice. Website:

<http://vimeo.com/19581877>

Sound Predictions 2009 Collaboration was a multi-agency field experiment in Prince William Sound led by the Alaska Ocean Observing System (AOOS) and partnering with COSEE NOW, and served as the perfect opportunity for COSEE-Alaska to increase public and K-12 audiences' awareness about ocean science research. Outcomes included podcasts, lesson plans for educators and videos.

Links:

<http://coseenow.net/podcast/2009/09/prince1/>

<http://coseenow.net/podcast/2009/10/prince2/>

<http://www.youtube.com/watch?v=OpQngP9HmKo>

<http://www.youtube.com/watch?v=RkGs4GQMW7Y>
<http://www.youtube.com/watch?v=tVFwxca2Xlk>
<http://www.youtube.com/watch?v=e4CRGHRErFs>
<http://www.youtube.com/watch?v=Q3n4gPwFQ9A>
<http://www.youtube.com/watch?v=nIsAPd1l8pw>
<http://www.youtube.com/watch?v=tVFwxca2Xlk>
<http://www.youtube.com/watch?v=S1PjRQxsQ4c>
<http://www.youtube.com/watch?v=8-Jqk9bSgw4>
<http://www.aos.org/>



Marine laboratories, although diverse institutions, produce a great deal of coastal and marine science, and marine-lab scientists are among the most active providers of information about ocean sciences content and the process of science, including access to real-time data, new results and discoveries. Despite diversity, marine-labs are unified by their role in providing direct access to research results in ocean sciences, research experiences for students and others, and education at various levels. Thus COSEE – Pacific Partnerships (PP) has focused on marine laboratories as places to engage scientists and carry out programs. Because Oregon has two marine labs they were an obvious initial partnership for developing a COSEE Center, and because marine labs are networked in the National Association of Marine Laboratories, there has been provision for dissemination and additional partner opportunities at marine laboratories in Washington, California and Hawaii.

The 2006 call for proposals for new COSEE Centers provided the impetus to act on ideas that had been under discussion in the marine laboratory community for a number of years. One topic of interest was how and where college students gained information about the ocean. It became clear that community colleges played an important role in answering this question. Almost half of the undergraduates in the US attend a community college and a large number of students, including many who go on to be teachers in the public schools, take their only college level science courses at community colleges. Classes that include ocean sciences topics are taught in a variety of departments, often by adjunct faculty members, who may or may not be ocean scientists. This suggested that community college faculty would be an audience that would greatly benefit from professional development opportunities that included working with and learning from ocean sciences researchers.

Our initial approach to working with the community colleges was to assess needs by hearing from community college faculty and administrators throughout the region. Using this information we have offered a series of professional development workshops that focus on ocean sciences content and how it could be used in the community college classroom which have involved university researchers and community college faculty. These workshops have provided the seeds for developing an ocean sciences college community, and we maintain a list serve that has regular postings of interest to the community college faculty. We anticipate strengthening the developing partnership with the *Geosciences in the Two Year Colleges* project hosted by the *National Association of Geoscience Teachers On the Cutting Edge* project (<http://serc.carleton.edu/NAGTWorkshops/index.html>).

We were also aware that community colleges provide access to a diverse audience; nationally 53% of Hispanics, 45% of African Americans, 52% of Native Americans and 40% of first generation college students in higher education are enrolled at community colleges. These statistics suggested that if we are interested in diversifying the ocean work force we should develop ways to encourage community college students to consider a path that might lead to such a career. Marine labs have a long tradition of encouraging undergraduate research, and we have drawn on that strength to develop a program that provides community college students with

opportunities for research experiences that may lead to an increased interest in ocean sciences. Much like the NSF REU program, our *Promoting Research Investigations in the Marine Environment* (PRIME) program places community college students with a marine lab researcher for an 8 – 10 week summer experience. Community college students however, do not have a culture of applying for research opportunities, so we have played an important role in facilitating the interest, mechanics and interactions between student and researchers in this program.

The second programmatic focus of COSEE – PP emerged from our initial planning meetings because of the free choice learning research strength at Oregon State University. If one looks at life long learning up to 95 % of one's life is spent outside of formal education. Since ocean sciences are largely absent from the K-12 curriculum nationally, most people are likely to learn most of the ocean sciences they know anything about from free-choice learning opportunities within informal education settings. However, informal science education professionals and volunteers traditionally have had little access to current ocean sciences information, so developing educational and professional development opportunities for this audience emerged as a priority for our Center. The scope of possible directions for this focus is large, so we looked for opportunities with partners who were ready to engage with us. One such group was the newly organized Oregon Master Naturalist Program (OMNP). The OMNP is developing a cadre of citizen volunteers to enhance public awareness of Oregon's natural resources through conservation education, scientific inquiry and stewardship activities. We have partnered with the OMNP to support the development of the program on the Oregon coast, specifically assisting scientists in developing and presenting the curriculum for the coastal eco-region.

In order to develop curriculum for educating volunteers that would simultaneously inform them about current ocean sciences content while helping them develop skills in interpreting that content for public audiences, we turned to the successful *Communicating Ocean Sciences to Informal Audiences* curriculum developed by COSEE CA. Our partnership with Oregon Coast Aquarium gave us a perfect opportunity to adapt COSIA for volunteer training. What we learned about striking a balance between content delivery and modeling good adult teaching and learning is now shaping all of our curriculum development.

In addition to the work with COSEE CA, we have also drawn on the strengths of other COSEE Centers to engage productive interactions between scientists and informal education partners. Specifically, we have worked with COSEE OS to adapt their very successful concept-mapping workshop curriculum to the needs of West Coast ocean scientists and informal educators. Workshops in Oregon and California have helped us broker what we believe will be longer term relationships between scientists and informal educators.

The success of COSEE – PP activities relies on the engagement of scientists in our activities and we have tested a number of approaches for providing opportunities and support for the broader impact of their research. We have learned that no single outreach opportunity or method is ideal for all scientists, or all outreach and education professionals. Scientists at different points in their career need different programming and assistance. Post-docs and graduate students need different support than established, tenured faculty. Additionally, there are multiple different models for how a scientist can interact with and meet the needs of community college faculty and students, informal educators on the floor of aquariums, afterschool science club leaders,

museum volunteers, and master naturalists. As a result, we continue to test, assess and refine ideas that we have developed and are working to make our evaluation and research findings available to the broader ocean sciences and education communities.

Significant Contributions not included in the COSEE Pacific Partnerships (PP) Highlights

Developing a relationship with Association of Zoos and Aquariums

COSEE PP has been developing a relationship with the AZA Board of Regents to study the need for professional development and certification of both education and husbandry staff for communicating ocean sciences. We have presented findings from a needs assessment that included over 90 educators and husbandry staff to the Board of Regents at their Annual Meeting at the Oceans 2010 Conference in Portland, OR. We are currently working with the Board of Regents to develop to a list of COSEE PP-affiliated online of professional development opportunities for education and husbandry staff.

Engaging Scientist Workshops

COSEE PP has provided a series of workshops aimed at engaging scientists in ocean sciences education and outreach. Four workshops presented information to ocean scientists on how to communicate with general audiences and how to build partnerships for broader impact and outreach activities. 36 scientists representing four universities and three federal agencies attended the sessions, including from NOAA, EPA, Oregon State University, Portland State University and University of Washington Vancouver.

Concept mapping workshop with scientists and educators

This workshop paired five ocean scientists from California Polytechnic State University, San Luis Obispo, and ten informal educators from the central California coast. It used online tools developed by COSEE OS for building relationships between the participants by building concept maps of the scientists' work that could be used to develop programming at each ISE site.

Engaging Graduate Students

COSEE PP has supported professional development of graduate students through workshops on how to effectively communicate their science using COSIA principles, how to produce effective scientific poster presentations, involvement in producing lyrics for the Banana Slug band's *Only One Ocean* CD, and involvement in producing messages for Earth Gauge.

Dissemination of the COSIA course

COSEE PP continues to offer the COSIA class to graduate students at Oregon State University in the department of Science and Math Education. COSEE PP is also currently assisting two marine laboratories - Humboldt State University (California) and Shannon Point Marine Center (Western Washington University) to implement COSIA classes for their graduate students in the next year.

From catastrophic storms to sea level rise and rapidly eroding shorelines, to harmful algae blooms, expanding dead zones and declining fisheries, we are becoming increasingly aware of our changing coastal oceans and how they impact our lives. Although we find these and other disturbing trends in the coastal ocean featured every day in news articles, the general public still poorly understands their causes and consequences. In general, the science associated with these issues does not reach most people. COSEE Coastal Trends was established in 2007 to address issues facing our changing coastal oceans through partnerships among research scientists, educators and students. A major environmental challenge for our generation is to comprehend and ultimately manage the myriad changes occurring in the coastal ocean. Understanding how climatic and anthropogenic factors drive these coastal trends requires basic science literacy. Our approach is to increase coastal Ocean Literacy through a series of programs, compilations, dissemination of products, and engagement of a wide variety of audiences.

Initially COSEE Coastal Trends implemented the *Scientist-Educator Partnership* (SEP) to accomplish our goal of increasing Ocean Literacy through partnerships among scientists, educators and students. Using a set of integrated activities, these partnering teams have been developing “coastal trends modules” for the K-12 classroom and the general public. The SEP team includes an ocean research scientist, a graduate student, a secondary school educator, and an underrepresented college student. This four-member team works together for six weeks of the summer to conduct research related to coastal systems issues and develop an educational module based on this research. Evaluation of the SEP has indicated that the outcomes of the program improve scientist communication/pedagogy skills, provide scientists with a venue for applying research to broader audiences, help advance teacher/student understanding of ocean sciences research, and assemble an education module that communicates the scientists’ ocean sciences research to formal and informal audiences.

Since its inception, COSEE Coastal Trends has hosted five SEP teams. Because several of the projects involved multiple investigators, the program has served as broader impacts for 80 ocean scientists and graduate students. Our experience thus far in developing the SEP model has provided lessons learned– the “host” scientist must have an active experimental ocean sciences research program during the time of the Partnership program, more time and focus should be given to the college students’ and teachers’ research experience, and structural guide lines for the program and module development are essential to insure timely development.

COSEE Coastal Trends has developed several mechanisms to disseminate the SEP education modules through partnerships with school districts, aquaria, and other institutions. In partnership with a local school district, Queen Anne’s County Public Schools (QACPS), COSEE Coastal Trends received additional NSF funding to assemble a semester-long, entry-level secondary school ocean sciences curriculum titled *An Introduction to Our Dynamic Ocean* (NSF OCE 0827805). During school year 2008-2009, the curriculum was piloted in three high schools; two in QACPS and one in Lee County, AL. Two implementation workshops were held for teachers across the nation. Initial evaluation results indicate that most of the teachers from the workshop are currently using materials from the curriculum. The ocean sciences course curriculum provides a framework to apply the high-quality ocean sciences education materials produced by SEP Teams and an organized means of broader dissemination of these materials.

COSEE Coastal Trends is partnering with the Horn Point STEM Center and regional public school districts to integrate science research into each school system's curricula. As part of these initiatives, we have implemented an externally funded program for all 7th grade students from DCPS, all 8th grade students from TCPS, all 9th grade students from QACPS, and all high school STEM students from two of the districts. Program activities are based on the SEP program education modules and are designed to increase students' ability to comprehend scientific processes, including hypothesis formulation, conducting research, data analysis, interpreting results and communication of conclusions. COSEE Coastal Trends partners with the Virginia Aquarium and Marine Science Center (VAMSC) to extend the education modules developed by the SEP to public audiences through several programs, including *Communicating Ocean Science for Informal Audiences* (COSIA), *Mentoring Young Scientists* (MYS), and *Coastal Trends Weekend*. COSEE Coastal Trends has partnered with COSEE California to develop the COSIA course for undergraduate students at Hampton University.

Addressing Underrepresented Audiences

Our approach to addressing underrepresented audiences has been one of integration, particularly in the SEP. COSEE Coastal Trends engages college students from under-represented groups in meaningful research experiences with the aim of diversifying the scientific workforce.

Undergraduates from our partnering institution, Hampton University, a privately-endowed, non-profit, non-sectarian, co-educational, historically black university have played an integral role in the SEP. Feedback from these students indicates that their experiences in the partnership helped prepare them for careers in science and offered opportunities for learning that they would not have otherwise received. After participating in the partnership, 100% of these undergraduate students have gone on to graduate programs in geology or marine science. These students have also presented their work at professional conferences such as ASLO. Additionally, half of the educators in our SEPs were minority teachers from Maryland public schools and 12 % of the teachers in our COSEE Coastal Trends workshops have been minorities. Of our school district partners, two districts have more than 45% underrepresented students in the sciences.

Significant contributions

Creation of coastal science education modules:

From the Land to the Sea module (2010)

http://www1.coseecoastaltrends.net/modules/from_land_to_the_sea/

Marine Bacteria Module (2009).

(http://www1.coseecoastaltrends.net/modules/marine_bacteria/get_started/).

Fish and Physics Module (2009).

(http://www1.coseecoastaltrends.net/modules/fish_and_physics/get_started/).

Dead Zone Module (2008).

(http://www1.coseecoastaltrends.net/modules/dead_zones/get_started/).

Seagrass Module (2008).

(http://www.coseecoastaltrends.net/modules/seagrass/get_started/).

Observing the Ocean module (2008).

http://www1.coseecoastaltrends.net/modules/observing_the_ocean/

Creation of an Ocean Science Curriculum:

An Introduction to our Dynamic Ocean: (http://www1.coseecoastaltrends.net/ocean_science) 2011.



Networked Ocean World

COSEE Networked Ocean World (COSEE NOW) is building an online network of scientists and educators focused on using emerging Ocean Observing Systems (OOS) technologies and real time data for public education across a broad continuum including community colleges, the K-12 formal education community, and informal learning institutions. The COSEE NOW team – with investigators from Rutgers University, Woods Hole Oceanographic Institution (WHOI), Liberty Science Center, Virginia Institute of Marine Science, Word Craft, University of South Florida, and Monterey Peninsula College’s MATE program – surveys and confers with educators and scientists on their use of ocean data to build the community’s knowledge and skills in using real time data in education and public outreach. OOS represent an exciting new paradigm of internet-based ocean exploration. COSEE NOW’s research and development projects focus on facilitating communications between educators and scientists; developing new data products and professional development services to improve communications and promote collaboration; and co-creating quality education and media products for use with the general public.

COSEE NOW was spawned from three of the original COSEE Centers funded in 2002: COSEE Mid Atlantic, COSEE New England, and COSEE California. COSEE Mid Atlantic (COSEE-MA), led by Rutgers University, focused on using real time data from ocean observatories in educational programs. The Rutgers University Coastal Ocean Observation Laboratory (COOLroom), created in the late 1990s by oceanographers Scott Glenn and Oscar Schofield, became the test bed for exploring the use of real time data streams from coastal New Jersey in both research and education. A series of innovative online tools emerged including the COOL Classroom, a web site providing lesson plans, and activities supporting the use of real time data in classrooms. From evaluation of our projects and programs, we learned a great deal about how educators use real time data in the classroom. In addition, this team also collaborated in national COSEE Working Groups on the development of common tools and strategies for engaging scientists in education and public outreach. The *Guide to Engaging Scientists in EPO*, published with the Oceanography Society, is designed to assist scientists with NSF Criterion II.

When a new COSEE RFP emerged in 2007, our unique group of scientists and educators jumped at the chance to collaborate on a common vision of using observatories to continue to build effective scientist-educator partnerships. Our goal was to explore ways of documenting big changes in the field of oceanography through the art of storytelling. By honing the skills of scientists and educators alike in the art of telling a story through words and data, we’ve made the story of OOS accessible and relevant. Secondly, we provide networking opportunities for scientists and educators to research and develop innovative strategies to use oceanographic data in teaching and learning. We assembled a team of highly regarded scientists and educators to share their knowledge, tell the story of OOS, and build connections and capacity in the emerging interdisciplinary field of oceanography. Since OOS technology is cutting edge and global in scale, our goal was to make the education side of our efforts complementary to the science.

Since COSEE NOW’s start in 2008, we have learned a great deal with many important collaborative learning experiences. Through the efforts of our Center evaluator, our constituents (audiences) have become our partners. By doing front end evaluation projects, we have learned

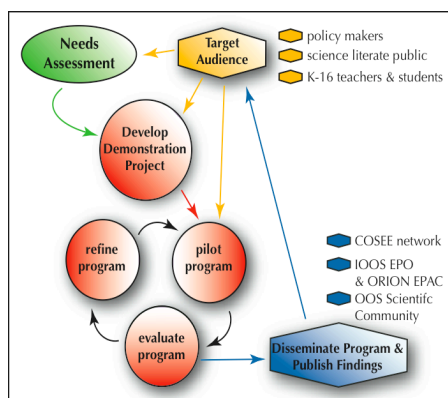


Figure 1: COSEE NOW follows this instructional systems design (ISD) model allowing us to plan effectively

what our scientists, classroom educators, and informal educators want and need with respect to OOS, and we have made them a part of the development cycle of identifying effective practices and products (Figure 1).

Our annual scientist survey provides a ten-year story of the opportunities and challenges scientists see in working with COSEE and thinking about engaging and educating the public in their scientific research.

By leveraging the COSEE NOW online tools, more than 50 COSEE NOW scientists have shared their research through our professional podcast program, *Ocean Gazing*. These podcasts are designed to capture the personal stories of scientists and their work and help them make their science accessible to the public. For example, by listening

to the needs of the emerging Integrated Ocean Observing Systems (IOOS) professional community, we have developed and used a blended approach of face-to-face professional development opportunities coupled with online webinars and blogging, to create a vibrant community of professionals learning from and sharing ideas with each other.



Figure 2: COSIA undergraduates practice effective teaching skills with middle school students attending the Marine Activities Resources & Education (MARE) Ocean Days.

Through the COSEE NOW network, formal and informal educators have mentored young scientists in our *Communicating Ocean Science for Informal Audiences* (COSIA) class taught at Rutgers University (Figure 2). Students benefited from online reviews and critiques of their lesson plans to be presented at the Liberty Science Center for museum guests.

Perhaps one of our proudest achievements has been the involvement of scientists seeking the assistance of COSEE

NOW in implementing their Criterion II projects. A network of approximately 100 scientists is now leveraging the COSEE NOW online infrastructure to engage with educator partners in effective education and public outreach. For example, COSEE NOW hosts the NSF funded *Ross Sea Connection* project. Dr. Josh Kohut, together with science photographer Chris Linder and writer Hugh Powell, have partnered with a team of informal and formal educators to share the research in Antarctica and the glider technology used to collect their data.

COSEE NOW has continued our emphasis on educating students and teachers, and the public on the availability and use of real time data. MATE's *Ocean Drifter* project incorporates ocean technology, real-time data collection, and data sharing into a community college curriculum. Thirteen faculty from around the country participated in drifter data collection and activities, resulting in the incorporation of real time data collection into 19 different courses. COSEE NOW is continuing to explore how to expand the use of real time data across the spectrum of learning – from undergraduate classrooms to the floors of science centers and aquaria.

What Is Next

Ten years of COSEE has brought a renaissance of partnerships and collaborators unprecedented in marine science education. We continue to be excited and honored to work together as research scientists, learning scientists, education practitioners, technologists, and students toward the important mission of creating an ocean literate society. We are improving our efficiency and expanding our collaborations into engineering and the community college community and we dream of using our local successes to expand our global reach with technologies and data from OOS.

Significant Contributions: COSEE NOW has made significant contributions in the OOS community and provided model lessons and resources used nationally. We selected five examples with links to further information.

Assisting scientists with Criterion II. The *Ross Sea Connection* (<http://coseenow.net/ross-sea/>) project provides an example of a NSF Broader Impact project successfully facilitated by COSEE NOW. Others include RU COLD <http://coseenow.net/rucold/> and Climate Change and the Atlantic Surf Clam Fishery <http://coseenow.net/surfclams/>.

Training for scientists and educators through face-to-face and online programs. COSEE NOW offered 24 webinars to build collaborations and capacity among scientists and educators. Early in its development, COSEE NOW provided storytelling training to engender a culture of connecting with your audience (<http://coseenow.net/blog/2009-oos-storytelling-workshop/>).

Ocean Gazing Podcasts (<http://coseenow.net/podcast/>) highlights the 50 podcasts done by Dr. Ari Daniel Shapiro. Companion **lesson plans** (<http://coseenow.net/blog/ocean-gazing-lesson-plans/>) were developed by VIMS, USF, and Liberty Science Center to help educators integrate the podcasts into learning experiences. Podcast clips are also accessible by cell phone on the museum floor of Liberty Science Center.

Using real time data (RTD) in education and public outreach has been a hallmark of COSEE NOW. *Ocean Drifters* (<http://coseenow.net/groups/mate-drifter-project/>) encourages community college faculty to engage their students in collecting and using RTD. COSEE NOW has provided training to education professionals (<http://coseenow.net/blog/using-ocean-data-in-education/>) to encourage them to share and discuss RTD use in education and public outreach. The *COOL Classroom* (<http://new.coolclassroom.org>) is a collaboration between the Rutgers Graduate School of Education and OOS scientists and explores the use of RTD and the development of interactive software.

Online resources such as (<http://coseenow.net/blog/antarctica-melting/>) were developed to help formal and informal educators access research through online media focused on scientists telling their story in their own words and pictures.



Leading an organization such as the National COSEE Network (NCN) is like piloting a ship in uncharted waters. COSEE is currently a community of fifteen Centers, comprised of over 280 institutional partners, each with unique goals and strengths. By supporting effective ocean sciences education, the NCN could have significant impact even without close inter-Center collaboration. Since inception, however, the NCN has had a National Coordinating Office (NCO) tasked with providing a level of organization that was unprecedented in NSF's Division of Ocean Sciences. Despite some initial "rough seas" with the initial NCO, the current NCO has achieved the goal of making the whole Network greater than the sum of its individual parts.

The NCO facilitates national meetings, provides an infrastructure for the Network's online presence, coordinates the National Advisory Committee (NAC), and provides guidance and support to individual Centers and Network working groups. The NCO also engages in Network-level activities such as the facilitation of broader impact activities, the establishment of partnerships and collaborations, Ocean Literacy initiatives, and the promotion of ocean related careers. Ultimately, the NCO serves as the hub of the Network, coordinating all COSEE Network activities and providing leadership.

From 2002-2007, the NCO was based at the Consortium for Ocean Leadership (COL) in Washington, DC. In 2008, the University of Rhode Island (URI) successfully competed to host the NCO at its Graduate School of Oceanography with Principal Investigator Gail Scowcroft serving as the Executive Director of the Network. Today's NCO has successfully implemented a "distributed leadership model" drawing on ocean sciences leaders from Florida to Maine. Key NCO team members are Annette deCharon (University of Maine), National Web Director; Billy Spitzer (New England Aquarium), Strategic Planning Lead and NAC Liaison; Liesl Hotaling (University of South Florida), Partnerships and Collaborations Coordinator; Andrea Gingras, Network Coordinator (URI); and Romy Pizziconi, Network Assistant (URI). By drawing from expertise within the Network to staff the NCO, Scowcroft has leveraged the team members' experience, Network memory, and Network connections to build a strong, cohesive National Network. Rather than depending on one individual to possess all the collective expertise needed to direct an enterprise such as the NCN, the Network greatly benefits from the individual and collective expertise of the NCO team members.

Network Meetings and Workshops

With a broad portfolio of projects, great ocean sciences education expertise exists within the Network. However, all Centers do not conduct all types of programming. Thus it is important for the Network to have a mechanism for sharing expertise and resources. It is also important for the Network to have opportunities to review its operations and plan for the future. To address these needs, the NCO coordinates and facilitates COSEE Council meetings and annual Network meetings. This has resulted in cross-Center activities such as the formation of the Network's

professional development working group, focused on the sharing and leveraging of educational resources.

The NCO has also initiated annual Evaluators Workshops and Effective Practices Work Sessions. Since 2008, the NCO has brought Center evaluators together to discuss individual Center evaluation methods and tools. Through these workshops the evaluators now have an understanding of the types of data that each Center collects. As a result, the evaluators have developed common Network metrics and are collaborating on Network-wide evaluation activities. In 2009, the NCO made a strategic decision to hold effective practices work sessions as a means for identifying the most effective practices being implemented in COSEE Center activities. Previously, Centers had little knowledge of models and project designs being implemented across the other Centers. These two annual opportunities for Network members to collaborate on the “nuts and bolts” of Center operations have greatly impacted evaluation activities as well as the design of Center activities. For example, based on the NCO’s analysis of Center models for the professional development of educators, Centers have placed less of an emphasis on one-day programs and focused more resources toward programs that allow more contact hours between scientists and educators. Summaries of the work sessions can be found at Best Practices in the Professional Development of Educators and Best Practices in the Engagement of Ocean Scientists.

Another key activity of the NCO is to promote the NCN at national science and education conferences. Over the last three years, the NCO has had a presence at the National Science Teachers Association, American Geophysical Union, American Society for Limnology and Oceanography, Ocean Sciences, Society for the Advancement of Chicanos and Native Americans in Science, the National Marine Educators Association, and IEEE/Marine Technology Society meetings. At these conferences (five education conferences and ten scientific conferences in thirteen states), the NCO has staffed a large exhibit and spoken with and engaged thousands of teachers, ocean scientists, and graduate students who may be interested in working with the Network or pursuing an ocean sciences related career. These activities would not take place without the NCO’s efforts.

National Website and Branding COSEE

The current NCO began working to strengthen the Network’s brand image as soon as it came on board, particularly through its print materials and online presence. These NCO activities have sparked a transformation in the Network’s image. For example, Network logos, headers, images and fonts are now adopted Network wide for use in presentations, brochures, letterhead, flyers, print advertisements, giveaways, and conference exhibits. COSEE.net and Center websites have been redesigned, using a Content Management System (CMS) managed by the NCO and guided by the Web Working Group (WWG). Use of the CMS allows much easier publication of upcoming Center events, Network news, resources for educators and scientists, and blog posts. COSEE.net also links to the password-protected COSEE File Manager, a repository designed by the NCO for COSEE’s archived materials, working documents, notes, presentations, contact lists, and general information that can be accessed and used by Centers, the NAC, and NSF. In addition to these products, the NCO manages, through the WWG and its “Excellence in Networking Tools” subgroup, Network-wide trainings in use of the CMS and other online tools to support Center activities and communication. The NCO has also designed and launched the

monthly *COSEE Network News*, a public newsletter that reaches over a thousand subscribers. The newsletter promotes COSEE's "brand" and provides a means of highlighting Center and NCO news and activities to the Network and the public. The newsletter is archived and available on COSEE.net (<http://www.cosee.net/about/cnn/>).

Strategic Planning

In March 2009, the NCO initiated a new strategic planning process for the NCN. The result is the NCN Strategic Business Plan (SBP) and its three-year implementation plan. The NCO has led the Network in making a significant change in its operations, as it takes the lead each year in developing an Annual Operating Plan (AOP) that provides an opportunity for the Council to reflect on COSEE's core mission, the work of the past year, changes in external circumstances, and challenges and opportunities for the upcoming year. The AOP delineates concrete steps for achieving annual Network goals, and progress on the plan is reviewed throughout the year. This has increased Network productivity while building capacity and cohesiveness.

National Advisory Committee

The current NCO reorganized the COSEE NAC and diversified its membership. The NCO coordinates this key Network body and provides it with any resources it may need to make recommendations to the Network. The NAC members are highly valued members of the COSEE community. This reconstituted NAC has been a guiding force in shaping the Network for the last three years. They were instrumental in assisting with the development of the Network's new SBP.

Partnerships and Collaborations

Another key NCO focus is the development and fostering of new Network partnerships. In 2010, the NCO brought on board a Partnerships and Collaborations Coordinator. In the last year, the NCO has initiated new partnerships with the American Meteorological Society to focus on how to share ocean sciences education materials; the American Society of Limnology and Oceanography (ASLO) Multicultural Program, which has resulted in a workshop for Young Investigators focused on broader impact activities and proposal writing; and the Inner Space Center to prototype infrastructure, hardware, and software to deliver feeds from the U.S. research fleet to informal science education institutions. The NCO is also partnering with several other organizations and societies in exhibits and programming at national meetings.

The strong NCO leadership team works well together and is seamlessly integrated into the Network. It has led COSEE's fleet of Centers into the calm seas of a well-established and healthy Network with a strong NAC. National operations are running smoothly, and the infrastructure is in place that will allow COSEE to continue its growth and thrive. The future for ocean sciences education in the U.S. is bright. This is in no small part due to the work of the hundreds of COSEE Network members nationwide. Building on COSEE's achievements to take advantage of new opportunities in cyberinfrastructure and advancements in the learning sciences will ensure the advancement of ocean sciences education. The NCO is poised to provide the necessary leadership to ensure COSEE's future success.



Ocean Communities in Education And social Networks

“It’s not just what you know, it’s who you know.”

Relationships are based on trust and respect. Partnerships and collaborations in research and education are ultimately dependent on the interactions of individuals from a diverse set of backgrounds, within a wide range of institutions. Bridging the cultures of formal education, informal education, and ocean research requires experience, skill, and time. With the goal of creating productive partnerships between scientists and educators in order to promote Ocean Literacy in a variety of educational settings, COSEE Ocean Communities in Education And social Networks (OCEAN) leverages existing educational networks that broaden the reach of the COSEE Network and increase the impact of excellent ocean education products and models.

The COSEE Network has evolved to the stage in which high quality ocean education products, effective models for engaging ocean scientists in education and outreach, and sustainable ocean education networks now exist. The Network is now in a position to share its substantial capacity with other existing professional and social networks in order to increase innovative and catalytic activities and to broaden the reach and impact of COSEE. In contrast to the COSEE Centers that are connected through institutional relationships, COSEE OCEAN promotes Ocean Literacy and engages ocean scientists through existing educational and professional networks as well as informal social networks. For example, COSEE OCEAN offers opportunities for education and outreach to scientists through their existing professional society networks, many of which have education and outreach as part of their mission.

COSEE OCEAN was funded in 2010. It is a collaboration among the University of Massachusetts (UMass Boston), American Society of Limnology and Oceanography (ASLO), New York Hall of Science, and Boston Public Schools. Supporting partners include the Lawrence Hall of Science and COSEE China. COSEE OCEAN has formed a partnership of well-connected and highly experienced individuals along with a carefully selected staff, and through its work will greatly broaden the impacts of the COSEE Network.

One of COSEE OCEAN’s partners, the American Society for Limnology and Oceanography (ASLO), has 4000 aquatic scientists as members. COSEE OCEAN is working closely with Adrienne Sponberg (COSEE OCEAN co-PI, ASLO Director for Public Relations), the ASLO Board, and the ASLO Education and Outreach Committee (Bob Chen, COSEE OCEAN PI, serves as Chair) to provide excellent professional development for ASLO scientists to climb the Ladder of Success in Ocean Sciences.

COSEE OCEAN is working with the COSEE Network to provide workshops on leadership in research, education, and diversity, thus increasing participating scientists’ capacity to develop

partnerships and collaborations; to broaden impacts of ocean research; to increase diversity in ocean sciences; and to create effective networks. Social network analysis will be used to target opportunities for engaging scientists in ocean education and outreach.

The Lawrence Hall of Science (Craig Strang, PI, COSEE California) has developed a grade 3-5 Ocean Science Sequence (OSS), published through Carolina Biological. COSEE OCEAN will build upon the strong partnership between UMass Boston and the Boston Public Schools to implement this excellent curriculum in a large urban district. (The Boston Public Schools have 60,000 students, 80% of whom are minority, 90% of whom receive free or reduced lunch). As the curriculum is piloted in Boston, COSEE OCEAN will develop a replicable model for district-wide adoption of the OSS by urban districts nationwide. With a focus on urban districts, ocean education materials and learning can reach underrepresented minority students and non-coastal students who do not currently have an understanding of the importance of the ocean. To efficiently utilize ocean scientists' expertise and passion for ocean science, COSEE OCEAN is exploring the use of short videos of ocean scientists explaining their work in order to engage students in the OSS.

The New York Hall of Science (NYSCI) is initiating an Inquiry Group centered on informal science education (ISE) and Ocean Literacy in the US. Informal education leaders from across a broad spectrum will explore the opportunities for and barriers to producing an ocean literate society that is able to make informed ocean policy decisions. The Inquiry Group will identify excellent education materials and effective models, and will recommend ways to improve dissemination of those tools to the ISE field for implementation. NYSCI will collaborate with networks such as the Association of Science-Technology Centers (ASTC) and the Center for the Advancement of Informal Science Education (CAISE), for which COSEE OCEAN co-PI Alan Friedman is also a co-PI, in order to carry out the Inquiry Group's dissemination recommendations. The goal is by enhancing the ISE network's collaboration, to increase the dissemination and implementation of ISE activities that promote Ocean Literacy.

While COSEE has established itself as the largest Network in ocean sciences education, there are in addition hundreds of institutions, projects, programs, and individuals engaged in STEM education initiatives. In line with the COSEE OCEAN theme, many STEM education networks may become linked to the COSEE Network. COSEE OCEAN has initiated interactions between the COSEE Network and the Math Science Partnership (MSP) Learning Network, containing over 160 funded MSPs between universities and school districts nationwide, and the GK-12 community, containing over 180 funded GK-12 programs, in almost every state, with links between universities and partner school districts. Connections within these learning networks contain potentially as many as 40 projects, each one as big as or bigger than a COSEE Center, which share common content emphasis on ocean sciences. COSEE OCEAN's engagement of these groups thereby greatly broadens the COSEE Network's potential resources, for both promoting Ocean Literacy and for engaging scientists in education and outreach.

Our vision is that within three years, ocean scientists will be more aware of and will have greater access to education and outreach opportunities within the COSEE Network; the COSEE Network will be able to exchange knowledge and resources with other STEM programs nationwide; informal education institutions will have increased their capacity to address public Ocean

Literacy; and a model for implementing a high quality ocean curriculum in diverse, urban school districts will be established.

Work is already well underway:

American Geophysical Union

“Using a Network Lens to Increase Your Capacity”, as part of Townhall session "Strategies for Effective Education and Public Outreach: Climbing the Ladder of Scientist Success.” American Geophysical Union (AGU) Fall 2010 meeting. A short presentation introduced participants to using networks to enhance their collaborations.

American Society of Limnology and Oceanography

“Understanding and Using Network Science for Better Collaboration,” a half-day workshop that introduced network science and its potential applications in educational and scientific endeavors. Dr. Karen Stephenson, President of Netform International and a featured thought leader by Malcolm Gladwell, author of The Tipping Point, presented the story of network science and a few of its provocative applications to academic and business settings. Ninety scientists had the opportunity to reflect on how this new knowledge may impact their proposals, research projects, and career trajectories.

<http://www.aslo.org/meetings/sanjuan2011/workshops.html#ws1>

Facebook

Graduate students for Ocean Education (GrOE) Facebook group initiated, to support young scientists interested in ocean education.

<http://www.facebook.com/home.php?sk=2361831622#!/COSEEGrOE>

Blogs

Network Science blogs on COSEE.net.

<http://www.cosee.net/news/blogs/index.cfm?BlogsAuthorID=53>

COSEE China

Guiding the development of COSEE China, an evolving network of 12 Universities in China interested in promoting ocean education.

<http://www.cosee.net/about/coseechina/>

COSEE OCEAN Website

<http://www.coseeocean.net/>



TEK Technology & Engineering for Knowledge

COSEE-Technology and Engineering for Knowledge (TEK)

Why COSEE-TEK?

“When I compare our high schools to what I see when I’m traveling abroad, I am terrified for our workforce of tomorrow.” —Bill Gates, Chairman and Chief Software Architect of Microsoft Corporation

“Having reviewed trends in the United States and abroad, the committee is deeply concerned that the scientific and technological building blocks critical to our economic leadership are eroding at a time when many other nations are gathering strength.” (Rising Above the Gathering Storm, National Academy of Science, 2005)

“However, the most pervasive concern was considered to be the state of United States K-12 education, which on average is a laggard among industrial economies – while costing more per student than any other OECD country.” (Rising Above the Gathering Storm Revisited: Rapidly Approaching Category 5, National Academy of Science, 2010)

“The present infrastructure is inadequate to meet the considerably expanded needs for instrument maintenance and calibration that will arise from the establishment of both research-driven and operational observing systems in the coming decade.” The National Research Council’s recent report “Enabling Ocean Research in the 21st Century

These statements reflect that our educational system is failing to engage and educate our students in science, technology, engineering and mathematics (STEM) and the consequences of this failure will challenge the U.S. in keeping pace with other global economies. The U.S. must regain its leadership in STEM education, which in turn, holds the key to innovation, discovery and economic growth. The ocean already is a major contributor to our nation’s economy with coastal states contributing 83% of our nations GDP. Ocean sciences and technology education has the potential to be a critical stimulus to provide opportunities for our economy and workforce.

Discoveries in science of every discipline have been enabled by advances in technology. Due to the challenge of the alien underwater world, however, this reliance upon technology is arguably greater for ocean sciences than any other field of scientific inquiry. Since the historic expedition of the HMS Challenger, the advancement of knowledge in ocean sciences has been directly coupled with and dependent upon the development and use of technological tools that have provided new data and insights into the ocean’s mysteries. It is, therefore, a natural evolution and a necessity to expand Ocean Literacy to include knowledge about the tools used to investigate ocean issues, and the skills necessary to develop and apply them.

What Will COSEE-TEK Do?

The goal of the thematic COSEE-TEK is to address the critical link between ocean sciences advancement and technological innovation. To meet this goal COSEE-TEK will:

- Sponsor **activities** that engage a community of learners comprised of research scientists, technicians and graduate students working with formal and informal educators to build knowledge, pedagogical insights, communications networks and educational resources that broaden the impacts of ocean sciences and technology development,
- Develop innovative **resources** such as an online database of broader impact resources that have been developed to highlight ocean sciences and technology and a “Techipedia” – a web-based tool to access information on the broad suite of ocean technologies being used to explore and understand the ocean today and
- Foster **communications and collaborations** amongst the ocean sciences, technology, education and public outreach communities through ocean technology webinars, seminars and speaker series – both live and online.

Who are COSEE-TEKs Partners

COSEE-TEK will succeed through the strength and breadth of partnerships. The Center is a partnership between the University of Connecticut, Project Oceanology and the Mystic Aquarium/Institute for Exploration – that represent the research institution-formal education-informal education troika that all COSEE Centers are built upon. Additional partners have been engaged to expand the Center’s spectrum of technologies and broaden the participation of underrepresented groups, such as University of Connecticut’s School of Engineering, American School for the Deaf, Louis Stokes Alliance for Minority Participation and National Association of Black Scuba Divers.

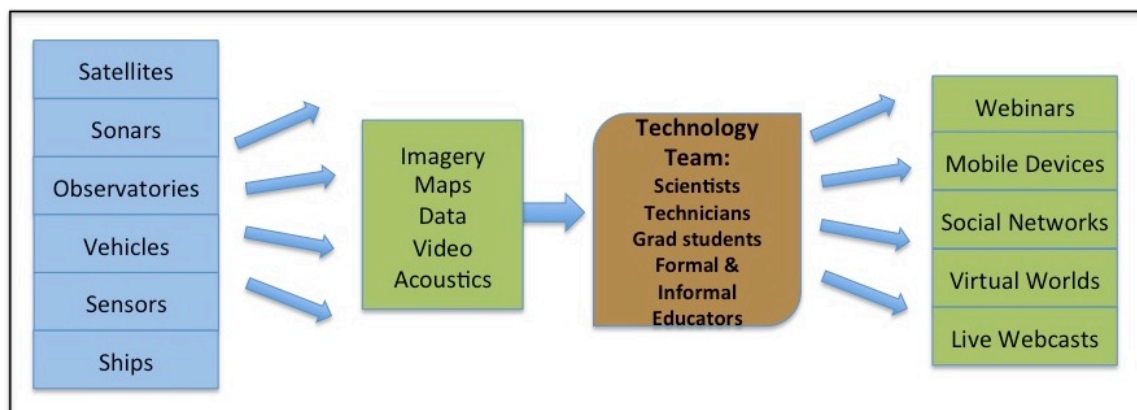
Part of COSEE-TEK’s mission is to be entrepreneurial in its approach – constantly on the lookout for emerging technologies and new opportunities to partner with researchers who are developing and applying cutting edge tools to better understand our blue planet. As these innovations arise COSEE-TEK will seek to work in partnership to identify ways to enhance the broader impacts of these technologies and their role in understanding the ocean. Seeking out these partnerships will be an ongoing activity of all members of the COSEE-TEK team. Examples of new partnerships that are being pursued include the Ocean Observing Initiative (OOI), U.S. Navy, Innerspace Center at the University of Rhode Island, and General Dynamics-Electric Boat.

COSEE-TEK is currently developing a partnership with COSEE-Southeast focused on the BOBs (Basic Ocean Buoys) initiative that is also supported by NOAA’s Integrated Ocean Observing System and the Southeast Coastal Ocean Observing Regional Association. COSEE-TEK is proposing to expand the sampling capacity of a BOB by installing passive samplers being developed by UConn scientist Penny Vlahos. The Center is also seeking to work with the entire COSEE network to highlight innovative broader impacts resources that they have developed with their partners that are focused on ocean technologies.

How Will COSEE-TEK Communicate - Ocean Technologies In...Information Technologies Out

Only a few years ago former U.S. Education Secretary Rod Paige declared: “Indeed, education is the only business still debating the usefulness of technology.” A report released four years ago (SEDTA, 2007) cited a U.S. Department of Commerce report stating: “In fact, education is the least technology-intensive enterprise in a ranking of technology use among 55 U.S. industry sectors.” At the same time a report entitled “Maximizing the Impact: the Pivotal Role of Technology in a 21st Century Education System (ISTE, 2007) recognized that technologies including videoconferencing, online learning, networking and instant messaging can support professional development and professional learning communities. Using technologies like these, educators can learn and collaborate with peers, mentors, experts and community members routinely. More recently a survey of 300,000 students seeking their vision of 21st century learning, students identified the need to integrate emerging technologies into the classroom including: 1) social-based learning to create and personalize networks of experts, 2) un-tethered learning enabled by technology and 3) digitally rich learning (Project Tomorrow, 2009).

To address the consensus need for enhanced integration of technology into K-12 curricula, COSEE-TEK will develop innovative activities and resources based upon the latest undersea technologies and apply emerging information and communication technologies to disseminate this content in meaningful, engaging ways. The ocean sciences and technology offer a rich set of tools that can be used to develop online problem solving opportunities. COSEE-TEK is currently exploring the role of mobile technologies in sending data from the field to schools, controlling remote devices, including underwater vehicles and providing the social network for broadening participation and impact.



Significant Contributions

Catalyzing Broader Impacts

Another partnership building effort of COSEE-TEK will draw upon the ubiquity of technologies in ocean sciences by providing technology-based broader impacts for research proposals being developed by research faculty, beginning with University of Connecticut researchers in year one. We will apply various elements of COSEE-TEK's proposed activities to these research proposals, such as expanding the Ocean Technology Experience to involve additional technologies. To date COSEE-TEK has partnered on six science and education proposals.

The Courtship of BOB and EVA

As a result of her involvement with the Deepwater Horizon oil spill, Dr. Penny Vlahos, UConn Department of Marine Science, began exploring the possibility of deploying her passive Ethylene Vinyl Acetate (EVA) based sensors on Basic Ocean Buoys (BOBs), an educational initiative being jointly developed by NOAA's IOOS, SECOORA and COSEE – SE. Dr. Vlahos and COSEE-TEK are currently developing a pilot program (hence the courtship) that would integrate her EVA sensors on BOBs in Long Island Sound to provide a novel technology-based monitoring program for teachers and students to track pesticides and emerging contaminants across the Sound. Dr. Vlahos and COSEE-TEK Director, Ivar Babb attended a workshop hosted by COSEE-SE, SECOORA, NOAA-IOOS and Jacksonville University where they learned more about the initiative and presented the EVA passive sensor technology as a potential tool for implementing on BOBs.



Connecting Florida to Ocean Science

In this self-portrait, our goal is to introduce the COSEE Florida team and paint a vivid picture of our Center and its vision for the NSF Decadal review panel. Led by seven Ph.D.s working from a geographic base on the eastern coast of central Florida, we are excited



to venture and proud to have been chosen to establish one of the newest Centers in the NSF Ocean Science Education Network.

As a group of scientists who have worked together for several years, we came together last year, took a step back and looked at the opportunities and challenges that we face in Florida from both a strategic and highly practical perspective. We asked ourselves the question:

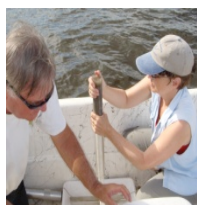
“What can we do to create a vibrant Center poised to use its talents and resources to help NSF engage more ocean scientists in COSEE while at the same time focusing our energies on a manageable number of activities likely to make a real and lasting educational mark in Florida?”

Opportunities and Challenges

We see Florida as a complex mix of challenges and opportunities. On the opportunity ‘side of the equation’, our potential audience and the public support base for ocean sciences research in Florida is huge – over 18 million citizens with about 80% residing within 20 miles of Florida’s 1300 mile long salt water coastline. The state also has a significant amount of ocean sciences intellectual capital – people and resources that we can access and engage. Florida is ranked eighth in the nation in overall NSF support with 74 current OCE PIs based in Florida and another 130 individuals who received OCE funding since 2003. When we reviewed the NSF awards database, we were encouraged to find that the percentage of OCE PIs who use educational activities to address Broader Impacts more than doubled between 2003 and 2010.



In our proposal, we identified two challenges facing the ocean sciences enterprise in Florida that we are confident that COSEE Florida can help address: the State’s low level of public Ocean Literacy and a growing shortage of well qualified middle school science teachers. If the state’s citizens remain as uninformed about the ocean and its role on our planet as we believe they are now, future public support for ocean research in the state could be in jeopardy. Also, if our institutions of higher learning fail to increase production of graduates with middle school science credentials, the quality of STEM education will decline and the number of students who enter ocean sciences careers will shrink along with Florida’s overall pool of scientific talent.



Our Vision

We are working hard to create a catalytic and collaborative Center that will creatively implement three strategic initiatives. Our first initiative will build a community of ocean scientists across Florida with excellent communication skills and a solid understanding of how to conduct quality education outreach. Our two companion educational initiatives will provide follow-on opportunities for scientists participating in COSEE Florida to practice their skills in real world settings while also helping Center staff contribute to improving public Ocean Literacy and expand and strengthen the STEM teaching workforce in Florida.



“What an amazing workshop! I got so much out of it, and I think it should be a requirement for all incoming biology graduate students”



“I enjoyed meeting real live scientists and experiencing directly the process of scientific discovery alongside fellow teachers.”

Our Three Initiatives with the Latest ‘Buzz’ on Progress

Initiative #1 – Professional Development Workshops for Scientists: PI Rick Tankersley from Florida Institution of Technology (Florida Tech) successfully conducted the Center’s first Presentation Boot Camp (PBC) on February 11th and 12th. 21 participants met on the Indian River State College (IRSC) campus and learned how to improve their effectiveness in communicating research activities and outcomes to non-scientific audiences. The workshop was fast-paced, engaging and highly interactive.

Two PBC iterations will follow this year in South Florida and North Central Florida. To expand our efforts as quickly as possible, Sue Cook and Valerie Paul have conducted two site visits and plan two more in March. Staff is building a database of Florida ocean sciences professionals (faculty, researchers, post-docs and graduate students) in preparation for a state-wide electronic needs assessment survey this spring. So far, the database contains 582 names from East Central, North Central and South East Florida.

Our second professional development series on developing quality education outreach programs is still in the design and testing phase. The series should roll out on the Treasure Coast in June with a second iteration in South or North Florida in September.

Initiative #2 – COSEE Florida’s Ocean Sciences Learning Network – Led by the Smithsonian Marine Station, but involving staff from all partners, this Network is the primary way that we will link scientists, educators and the public to our broader community across the state. To build this broad tapestry of ocean sciences knowledge and practice, we will work with partners at 6-8 informal education hubs to design customized education outreach and community events. Our first successful *Water as Habitat* public lecture and educator workshop combination “Exploring and Protecting Our Ocean Planet” on March 24-26 at IRSC reached a public audience of over 225 and provided professional development for 30 educators. Future events will continue to use the *Water as Habitat* theme to engage and ‘hook’ students and the public. Once the ‘hook’ is set, we then emphasize how charismatic marine organisms fit within a systems framework of physical, chemical and geological ocean processes. Our approach

CORE PARTNERS

Indian River State College

Dr. Ed Massey, PI; President
Dr. Sue Cook, co-PI; Director
Dr. Bill Tyler, co-PI; Professor
Dr. Jennifer Capers, co-PI; Assistant Professor
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Florida Institute of Technology

Dr. Rick Tankersley, PI; Professor

Ocean Research & Conservation Association

Dr. Edie Widder, PI; President
Mr. Giancarlo Cetrulo, Center Manager
Ms. Brandy Nelson, Research Associate

Smithsonian Marine Station at Fort Pierce

Dr. Val Paul, PI; Director
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Collaborators

Dr. Michael Spranger, Florida Sea Grant
Ms. Karen Blyler, University of Florida 4H Extension
Dr. Patti Bourexis, The Study Group

stresses partnerships with organizations that complement our expertise. Two potential future partners are NSF's Coastal Areas Climate Change Education (CACCE) project at the University of South Florida and the Chemical Oceanography Division of NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML).

Initiative #3 Ocean Sciences Concentration for Pre-Service Educators - To expand the skills and science knowledge of Florida's science teachers, COSEE staff are working with faculty and administrators at IRSC to design, pilot and spread the word about the State's first ocean sciences concentration within a Bachelor's science education curriculum for middle school science teachers. A three person team is updating an existing lower division oceanography course and designing a new upper division course that emphasizes understanding systems rather than the memorization of facts. Practical experience in crafting high quality lesson plans with an ocean focus will be incorporated into other courses in the concentration. In year 3, we will begin outreach to faculty and administrators throughout the 28 member Florida College System who wish to adopt all or part of this program on their campuses.

The announcement for our first summer *Research Experiences for Pre-Service Teachers* (REPT) program has just been posted on our website (www.coseeflorida.org.) These hands-on research experiences are essential for future science teachers to effectively 'hook' their students on science and help them better understand the role of science in society.

A Different Organizational Model

Our partnership structure differs from the norm in ways that we think add to our effectiveness. Our organizational lead Indian River State College (a 4 year teaching institution) has an efficient flat management structure and a highly collaborative culture; these qualities will help us be effective both in terms of program impact and cost. In addition, the College's leadership role in the 28-member Florida College System will be key as we seek to disseminate our ambitious community-focused educational initiatives and pre-service education curriculum across the state. The Smithsonian Marine Station has a small footprint, but is rich in informal education expertise and tightly linked to the U.S. National Museum of Natural History and the Smithsonian Institution. Edie Widder's Ocean Research & Conservation Association (ORCA) bridges the gap between science, ocean technology and marine conservation in a way that is charismatic and meaningful for students and the public. Florida Tech's proven model for communications training with its emphasis on documenting the impact of 'communications and outreach interventions' is an 'unsung jewel in our crown' and will enable us to show that our work has a positive effect on how scientists communicate. Our statewide outreach and dissemination partner is University of Florida's Sea Grant and Institute for Food and Agricultural Sciences Extension network with offices in all Florida counties.

We are also pleased to report that we have assembled an amazingly dynamic and committed leadership and organizational team. All of our PIs and co-PIs are doing research (Edie Widder, Rick Tankersley, Val Paul) or are former researchers who are now in positions to positively influence the outcomes of COSEE Florida. Ed Massey is President of Indian River State College. Bill Tyler and Jen Capers are innovative and creative teaching faculty while Sue Cook is focusing on directing Center operations and integrating ‘a doing science perspective’ into our education initiatives. The Center’s operational staff and consultants are all professionals with expertise in evaluation, formal STEM education, informal ocean learning and non-profit management.

Thank you for reading this self-portrait and supporting the vision and emerging reality of COSEE Florida!